

United States
Department of
Agriculture

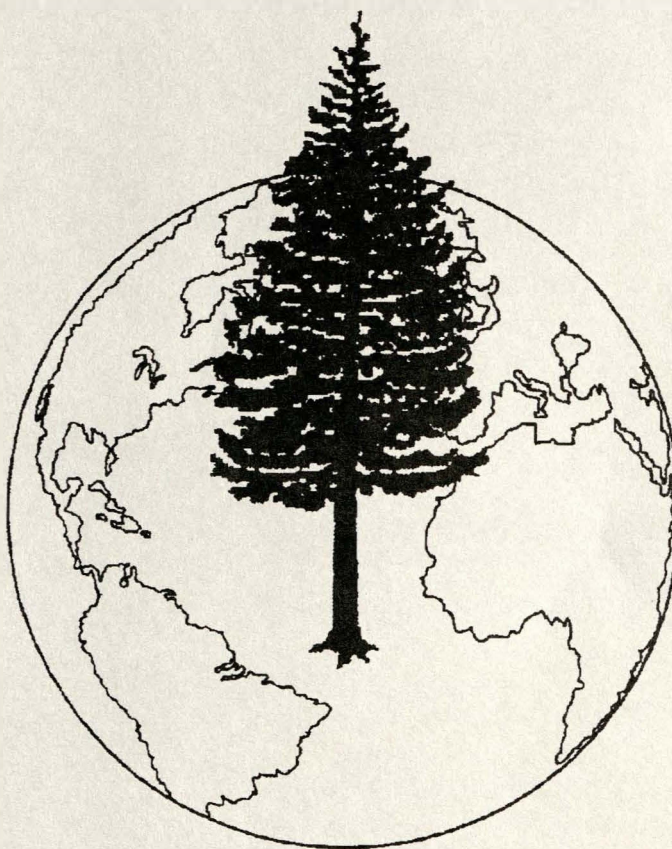
Forest Service

**Forest
Health
Protection**

December 1996



Forest Insect and Disease Conditions in the United States 1995



Healthy Forests Make
A World of Difference

ERATTA Forest Insect and Disease Conditions in the United States 1995

The bar graph on the bottom of page 10 belongs on the bottom of page 11 with the caption that reads "Spruce Budworm Defoliation in Eastern United States, 1976-1995".

The map on the bottom of page 11 belongs on the bottom of page 10 with the caption that reads "Counties Where Spruce Budworm Defoliation Reported in Eastern United States, 1995".

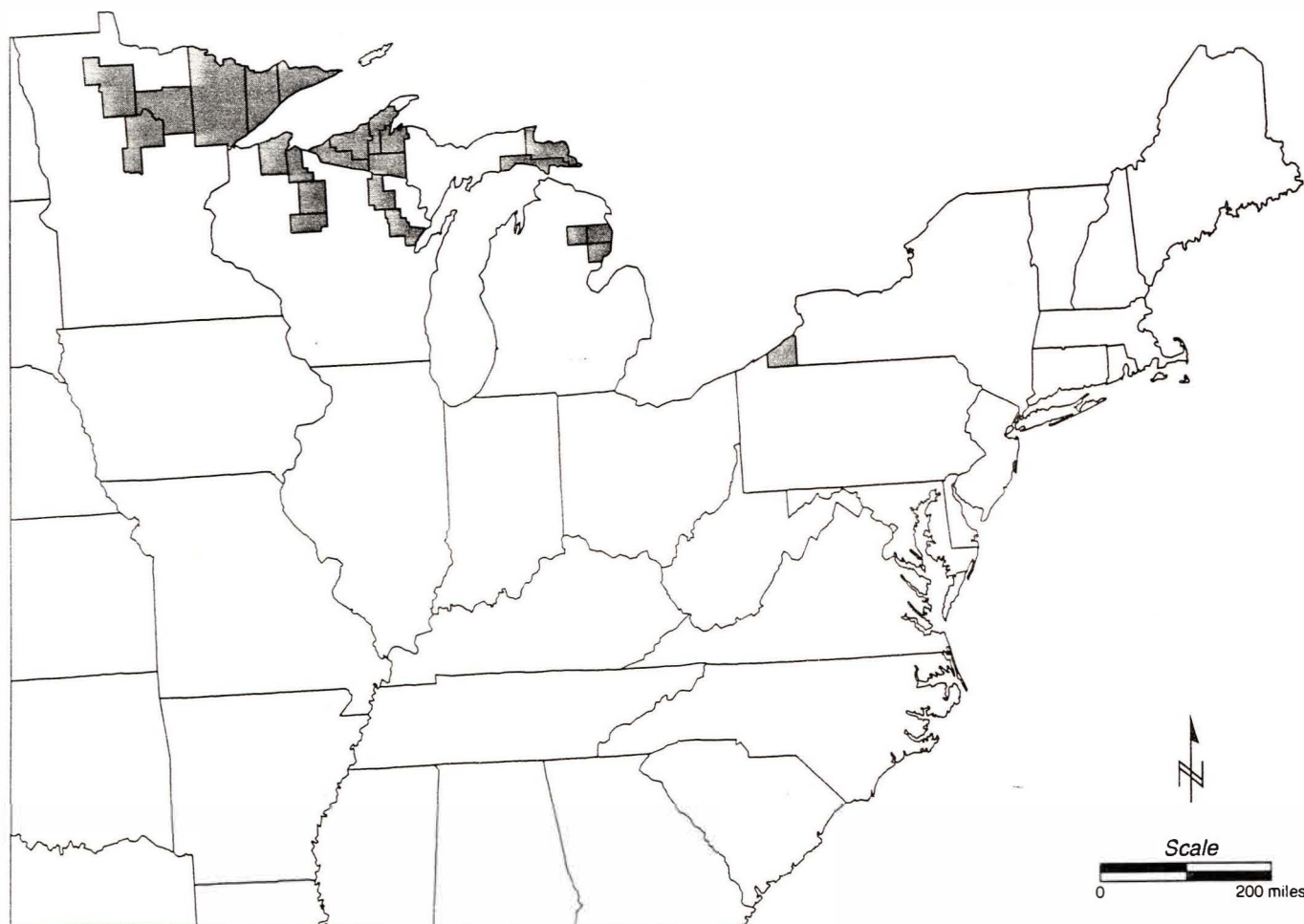
Spruce budworm (*Choristoneura fumiferana*) is a native insect found in northern New England, New York, the Great Lakes area, and Alaska. Balsam fir is the preferred host, but the insect also feeds on white, red, and black spruce. Top kill and tree mortality may result from budworm feeding. Outbreaks generally begin in extensive and continuous areas of mature and over-mature balsam fir.

In the Northeast and the Great Lakes, the acreage defoliated remains low following the outbreaks of the

late 1970's and early 1980's. Nevertheless, more than 500,000 acres of trees were defoliated in Minnesota in 1995, and budworm-caused defoliation has reappeared in Michigan, New York, and Wisconsin.

In Alaska, however, some areas have experienced five consecutive years of budworm defoliation by *C. fumiferana* var. *orae*, and var. *biennis*. Some top kill and tree mortality is occurring. The acreage defoliated increased from 232,500 acres in 1994 to 279,000 acres in 1995.

Counties Where Spruce Budworm Defoliation Reported in Eastern United States, 1995



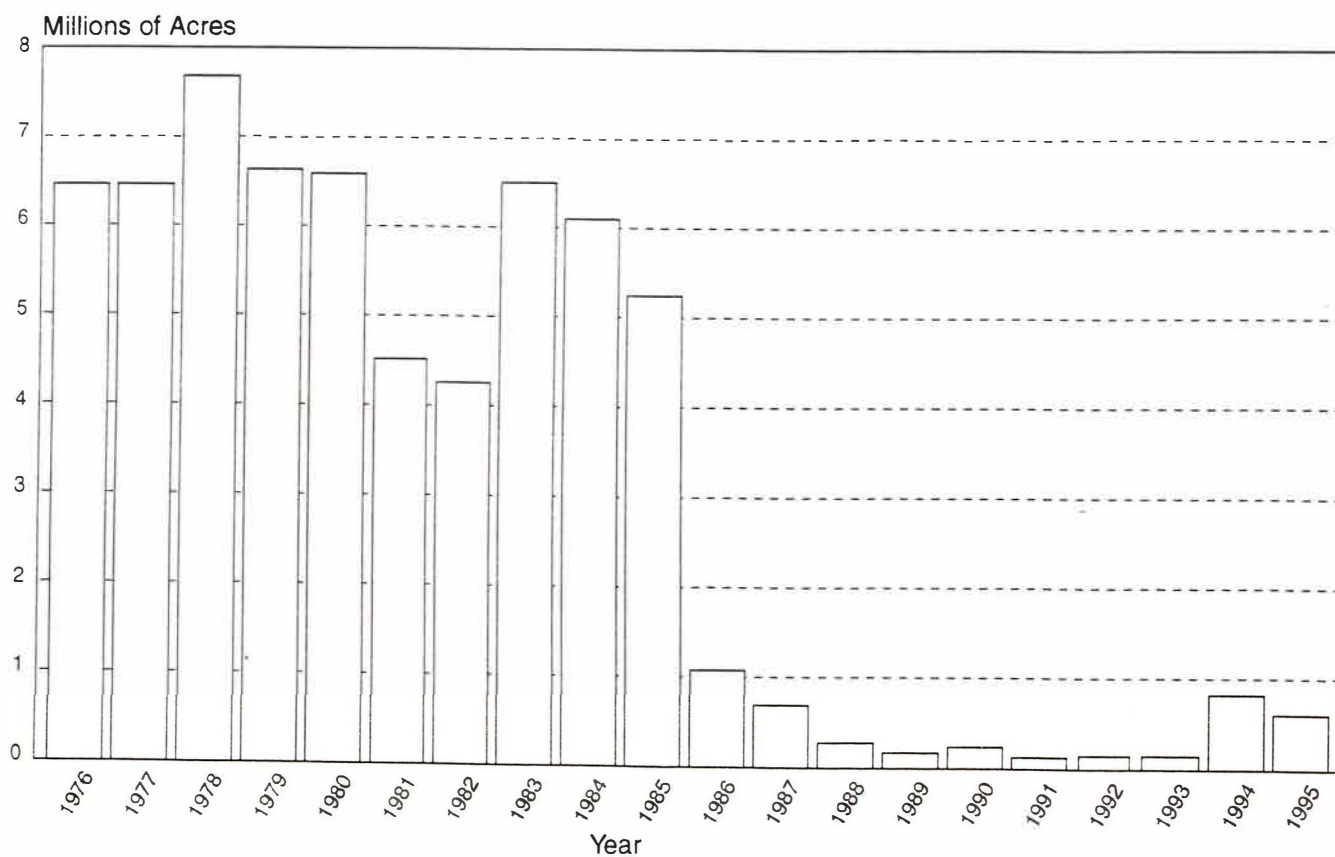
Acres (in thousands) of Aerially Detected Spruce Budworm Defoliation in Eastern United States, 1991-1995

State	1991	1992	1993	1994	1995
Maine	0.0	0.0	0.0	0.0	0.0
Michigan	0.0	0.0	0.0	6.8	51.2
Minnesota	108.0	126.0	116.0	770.5	505.0
New Hampshire	0.0	0.0	0.0	0.0	0.0
New York	0.0	0.0	0.0	0.1	0.4
Vermont	0.0	0.0	0.0	0.0	0.0
Wisconsin	0.0	0.0	0.0	1.0	12.5
Total	108.0	126.0	116.0	778.4	569.1

Acres (in thousands) of Aerially Detected Spruce Budworm in Alaska, 1991-1995

State	1991	1992	1993	1994	1995
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Spruce Budworm Defoliation in Eastern United States, 1976-1995.



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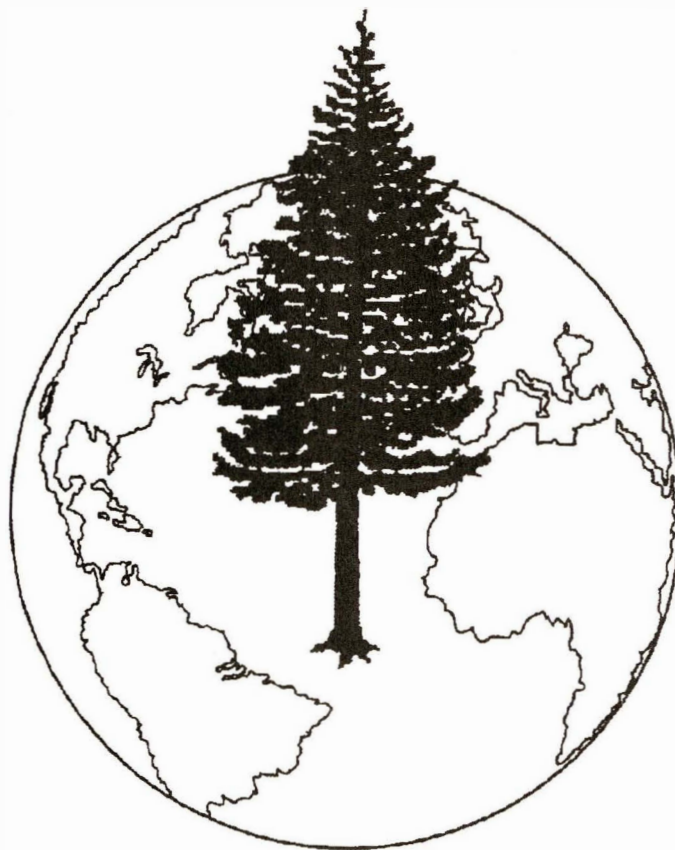
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Forest Insect and Disease Conditions in the United States 1995



Healthy Forests Make
A World of Difference

PREFACE

This is the 45th annual report prepared by the U.S. Department of Agriculture, Forest Service, of the insect and disease conditions of the Nation's forests. This report responds to direction in the Cooperative Forestry Assistance Act of 1978, as amended, to conduct surveys and report annually on insect and disease conditions on all forests of the United States. Included in the report are the insect and disease conditions of major national significance in 1995. Insect and disease conditions of local importance are reported in regional and state reports.

The report describes the extent and nature of insect and disease-caused damage of national significance in 1995. As in the past, selected insect and disease conditions are highlighted in the front section of the report. Maps are provided showing affected counties in the East and affected areas in the West. Graphs are provided for some pests showing acreage trends over the last several years. Also provided are tables showing acreages affected for selected pests by state by year for the last five years.

The second section of the report brings together insect, disease, and abiotic agent damage from each affected region under the organism's or agent's name. The organisms and agents are arranged alphabetically in the appropriate section: insects—native; insects—nonnative; diseases—native; diseases—nonnative; diseases—origin unknown; declines and complexes; seed orchard insects and diseases; nursery insects and diseases; and abiotic

damage. These categories are listed in the table of contents; there is no index.

The information in this report is provided by the Forest Health Protection Program of the Forest Service. This program serves all federal lands; including the National Forest System, the lands administered by the Departments of Defense and the Interior, and Tribal lands. The program also provides assistance to private landowners through the State Foresters. A key part of the program is detecting and reporting insect and disease epidemics, and the effects of wind, air pollution, floods, droughts, and other agents. Detection surveys are conducted on a regular basis by Forest Service and state program specialists.

For additional information about conditions, contact the Forest Service regional office listed on the next page (see map for office coverage) or your State Forester.

The Forest Service is also preparing a report "America's Forests: 1996 Health Update" that highlights major forest health concerns. The report will be available on the internet. The report discusses the changing ecological conditions in the intermountain west, east, south, and Alaska. The report also deals with exotic (non-native) pests, the rural-urban-wildland interface, and the effects of weather and air pollution to forests.

FOREST SERVICE REGIONAL OFFICES

Forest Service, USDA
Northern Region (R-1)
P.O. Box 7669
Missoula, MT 59807
(406) 329-3605

Forest Service, USDA
Rocky Mountain Region (R-2)
P.O. Box 25127
Denver, CO 80225
(303) 275-5074

Forest Service, USDA
Southwestern Region (R-3)
517 Gold Avenue, S.W.
Albuquerque, NM 87102
(505) 842-3245

Forest Service, USDA
Intermountain Region (R-4)
324 25th Street
Ogden, UT 84401
(801) 625-5252

Forest Service, USDA
Pacific Southwest Region (R-5)
630 Sansome Street
San Francisco, CA 94111
(415) 705-2660

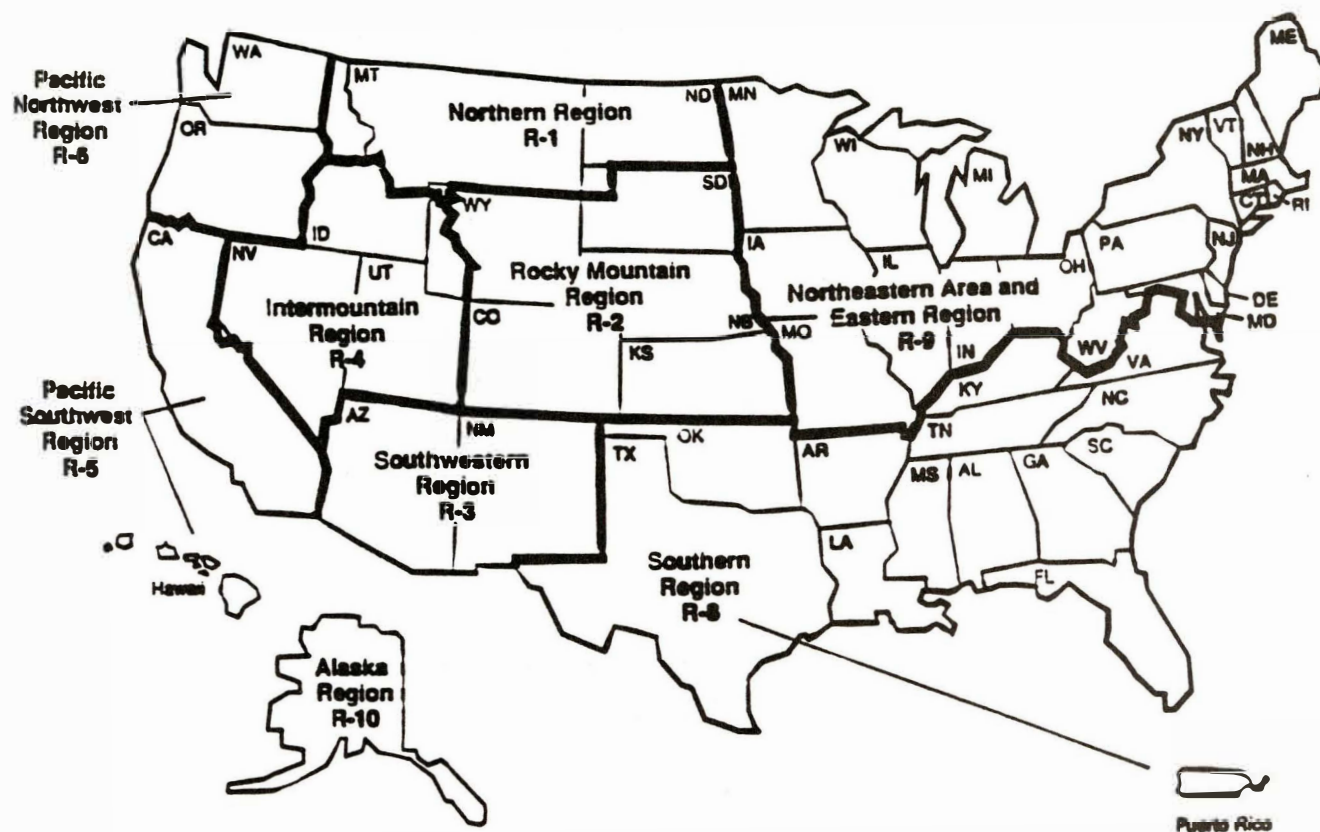
Forest Service, USDA
Pacific Northwest Region (R-6)
P.O. Box 3623
Portland, OR 97208
(503) 326-6666

Forest Service, USDA
Southern Region (R-8)
1720 Peachtree Road, NW, Room 925N
Atlanta, GA 30367
(404) 347-2961

Forest Service, USDA
Northeastern Area
100 Matsonford Road
5 Radnor Corporate Center Suite 200
Radnor, PA 19087
(610) 975-4124

Forest Service, USDA
Alaska Region (R-10)
3301 C Street, Suite 522
Anchorage, AK 99503
(907) 271-2575

USDA Forest Service Regions and Area



Copies of this report are available from the
Forest Service, USDA
Forest Health Protection, AB-2S
P.O. Box 96090
Washington, DC 20090-6090
Phone: 202-205-1600
FAX: 202-205-1139

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EXECUTIVE SUMMARY

Introduction

About one-third of the Nation's land area, over 730 million acres, is forested. These forests provide economic, social, and environmental benefits. Native and introduced insects and diseases as well as abiotic influences all effect the health and productivity of the forests.

Highlighted below, and in part 1 of this report, are some of the major native insects and diseases of concern. Also highlighted are some non-native insects and diseases that have been introduced into the United States. These pests either are causing serious damage or have the potential to do so.

Insects: native

Southern pine beetle—affected acreage increased from 5 million acres in 1994 to 22 million acres in 1995.

Mountain pine beetle—affected acreage increased by 170 thousand acres in 1995 to 575,500 acres.

Spruce budworm continues to defoliate 784,100 acres of trees in Alaska and Minnesota. The budworm has reappeared in Michigan, New York, and Wisconsin.

Western spruce budworm defoliation continues at less than half a million acres for the third consecutive year. Significant increases in acreage defoliated occurred in Colorado and Washington.

Spruce beetle infestations in Alaska reached the highest level in history in 1995—over 892,800 acres.

Insects: nonnative

Gypsy moth (European) rebounded from a low of 880,000 acres in 1994 to 1.4 million acres in 1995. Eradication projects were conducted in eight states outside the generally infested area.

Gypsy moth (Asian), a greater threat than the European form, was present in North Carolina and Washington. Eradication programs are under way.

Common European pine shoot beetle was discovered in 1992 in Ohio. The beetle was found in Maryland and West Virginia for the first time in 1995, bringing the total number of states to eight. State and Federal quarantines are in force.

Hemlock woolly adelgid was introduced into Virginia in 1950 and has spread north to southern New England. The insect was found in North Carolina for the first time in 1995.

Diseases: native

Fusiform rust is the most damaging disease of pines in the South. An estimated 13.5 million acres of pines are affected.

Dwarf mistletoes, native parasitic plants that grow on conifers, are the most serious disease of trees in the West. An estimated 28.9 million acres of conifers are infected.

**Diseases:
nonnative**

White pine blister rust was introduced around the turn of the century, and now occurs throughout most of the ranges of the five-needled pines, including eastern white pine, western white pine, and sugar pine, causing extensive tree mortality. In 1990, blister rust was found in New Mexico and is threatening the viability of southwestern white pine.

Beech bark disease is the result of an attack by the beech scale followed by invasion of a fungus. The scale was introduced into North America about 1890. The disease is found killing beech trees from Maine to Pennsylvania, with outlying spots in West Virginia, North Carolina, and Tennessee.

**Diseases: origin
unknown**

Dogwood anthracnose, first found in 1970's, is now found in 21 eastern states, as well as Washington, Oregon, and Idaho. The disease kills both woodland and ornamental dogwoods.

Butternut canker is found throughout the range of butternut. In the Southeast, 77 percent of the trees are dead.

**Conditions by
Agent**

Part 2 of this report provides more detailed information about these insects and diseases as well as others. The report also describes abiotic factors, such as wind and drought, that damage forests. Abiotic factors often predispose the trees to insect and disease buildups.

Part 1

National Highlights

Insect Conditions Highlights

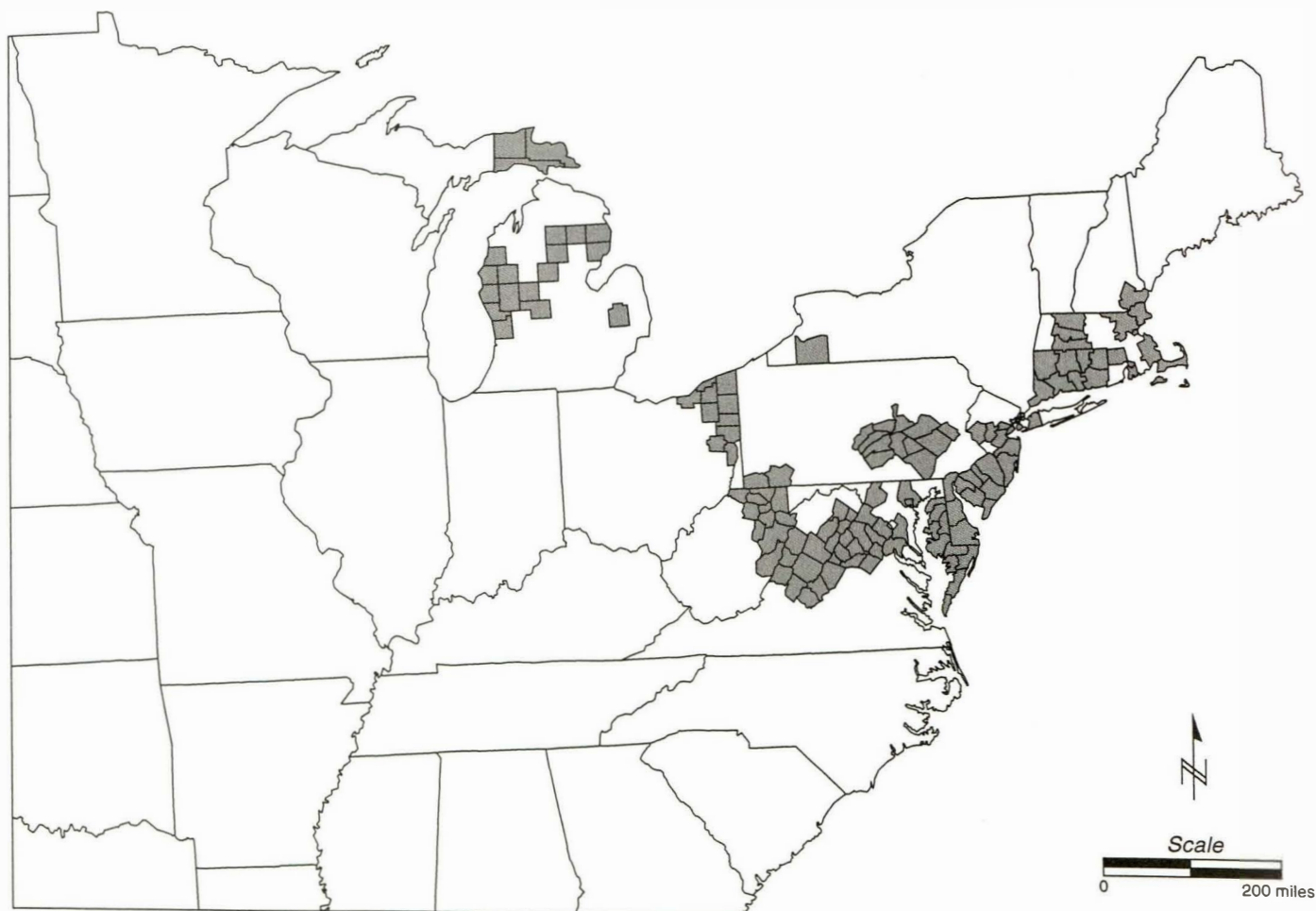
Gypsy moth (European form) (*Lymantria dispar*) was introduced into Massachusetts in 1869 and continues to spread to the south and west. In 1995, over 1.4 million acres of hardwood forests were defoliated from New England to Virginia and Michigan. This figure would be higher except for the suppression projects conducted on the highest-valued lands. Gypsy moth feeding results in growth loss, crown dieback, and tree mortality. Preferred foods include all oak species, sweetgum, apple, beech, and basswood.

Eradication projects were conducted on outlying infestations of European gypsy moths in Arkansas, Georgia, North Carolina, South Carolina, Tennessee, and Wisconsin. Eradication projects were also conducted in Ore-

gon and Washington. Both European and Asian gypsy moths were trapped in Washington in 1995. Eradication projects are planned for Georgia, North Carolina, Oregon, and Washington in 1996. European gypsy moths were trapped in several other western states as well.

In 1993 the Asian form of the gypsy moth, along with European and hybrid forms, was accidentally introduced into the vicinity of Wilmington, North Carolina, on a ship returning U.S. military equipment from Germany. An eradication project was conducted in 1994, with over 140,000 acres treated. A follow-up treatment of 2,000 acres was conducted in 1995, and another treatment of 3,000 acres is planned for 1996.

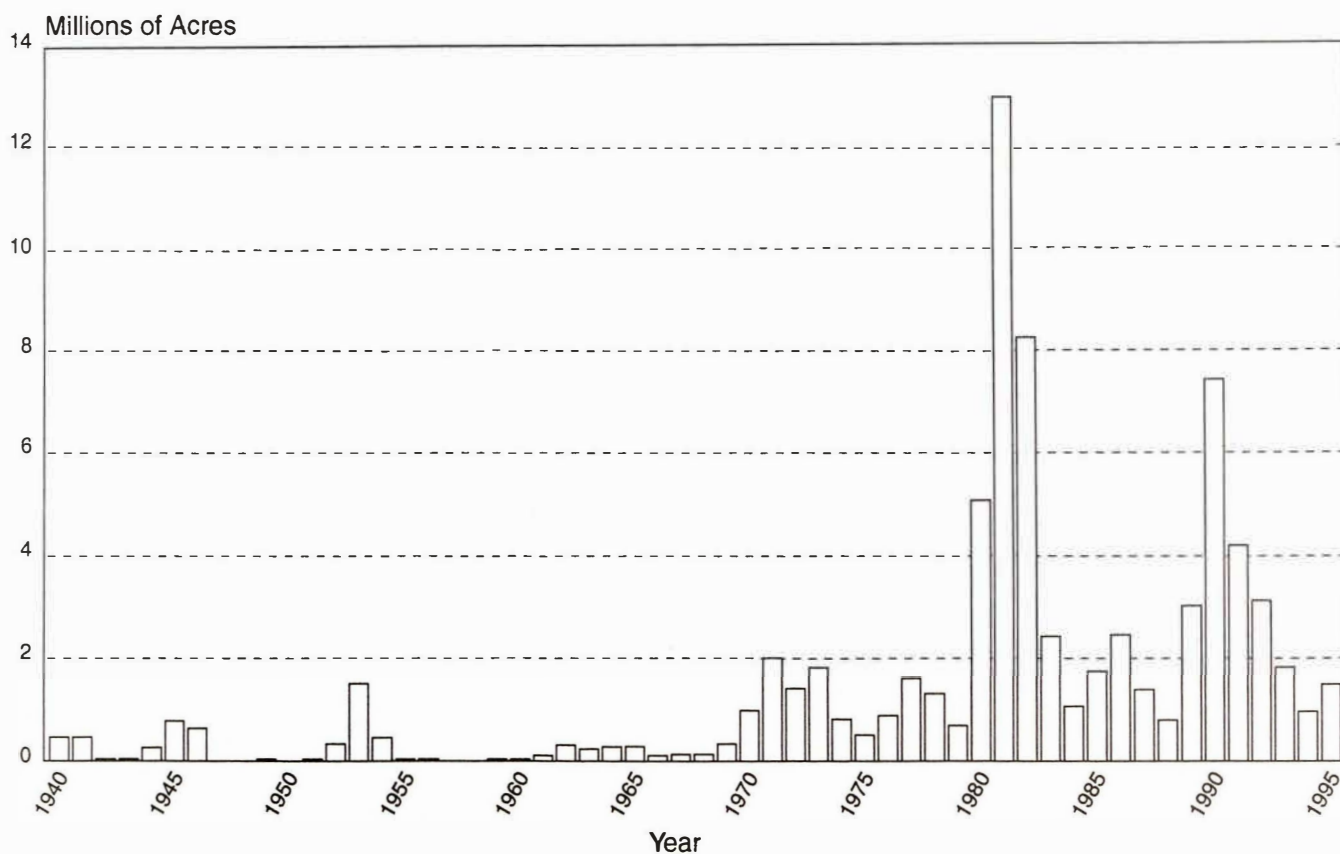
Counties Where Gypsy Moth (European) Defoliation Reported, 1995



Acres of Aerially Detected Gypsy Moth (European) Defoliation, 1991–1995

State	1991	1992	1993	1994	1995
Connecticut	50,154	31,637	0	0	2,700
Delaware	13,475	4,943	26,700	60,700	65,500
Maine	614,509	278,485	50,700	1,700	0
Maryland	75,197	38,704	68,900	93,200	93,900
Massachusetts	282,143	123,794	88,700	76,700	8,700
Michigan	626,689	712,227	399,300	97,300	85,900
New Hampshire	180,870	182,575	10,100	8,100	1,700
New Jersey	169,900	165,960	27,700	17,800	39,600
New York	175,960	60,022	2,000	500	200
Ohio	345	1,130	600	100	34,400
Pennsylvania	1,230,066	641,445	318,100	18,000	132,500
Rhode Island	0	0	0	400	0
Vermont	3,596	83	0	0	0
Virginia	616,200	748,000	589,100	452,500	849,000
Washington, DC	125	0	0	0	0
West Virginia	112,900	67,508	202,500	53,400	103,000
Total	4,152,129	3,056,513	1,784,400	880,400	1,417,100

Gypsy Moth (European) Defoliation, 1940–1995



Southern pine beetle (*Dendroctonus frontalis*) a native insect, is the most destructive of the eastern species of bark beetles. Southern pine beetle populations are epidemic in some parts of the south almost every year. Historically, eastern Texas and northwestern South Carolina have an inordinate amount of activity.

Annually, this beetle destroys timber trees worth millions of dollars and also affects recreation areas, shade trees, and general aesthetics. Infestations usually start in trees weakened by disease, lightning strikes, excessive age, storm damage, or other stress factors.

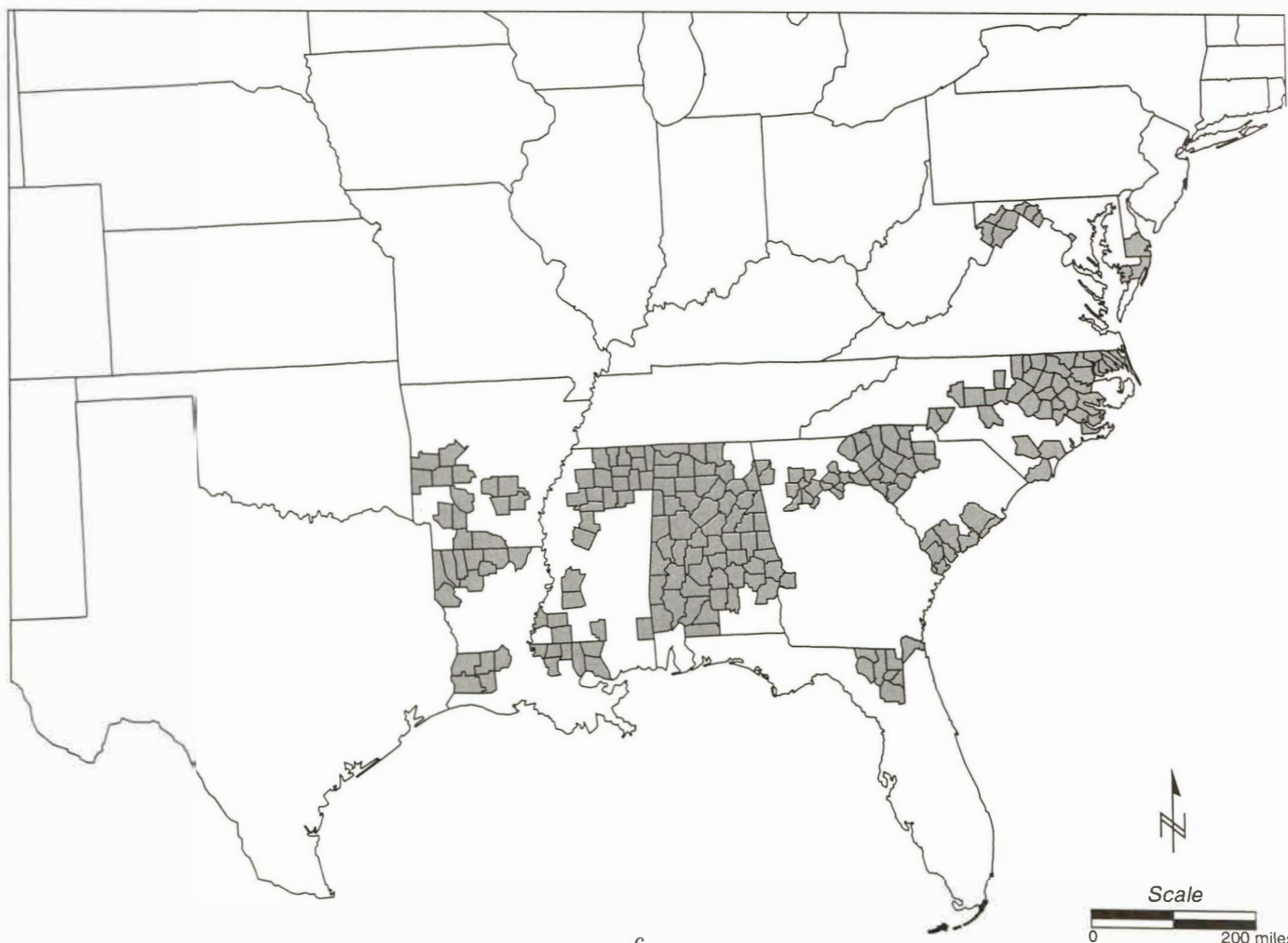
Acreage in the South affected by the southern pine beetle rebounded from a four-year low of 5.3 million acres in 1994 to a near record high of 21.7 million acres in 1995. The number of infestations (spots) increased from 10,700 in 1994 to 57,800 in 1995. In South Carolina, private

lands were most seriously affected: 22 of the state's 46 counties were in outbreak status.* The Governor declared a Forest Disaster thus allocating additional resources to combat the problem.

Southern pine beetle activity increased dramatically in Alabama, Arkansas, Georgia, Florida, Louisiana, Mississippi, and North Carolina as well. The noteworthy exception is Texas, (which historically has experienced severe losses) with no reported outbreak counties. Also, the record-high infestation in Virginia in 1993 collapsed in 1994 and remained low in 1995.

*Outbreak counties are defined as having one or more multi-tree infestations per 1,000 acres of host type.

Counties Where Southern Pine Beetle Outbreaks Reported, 1995

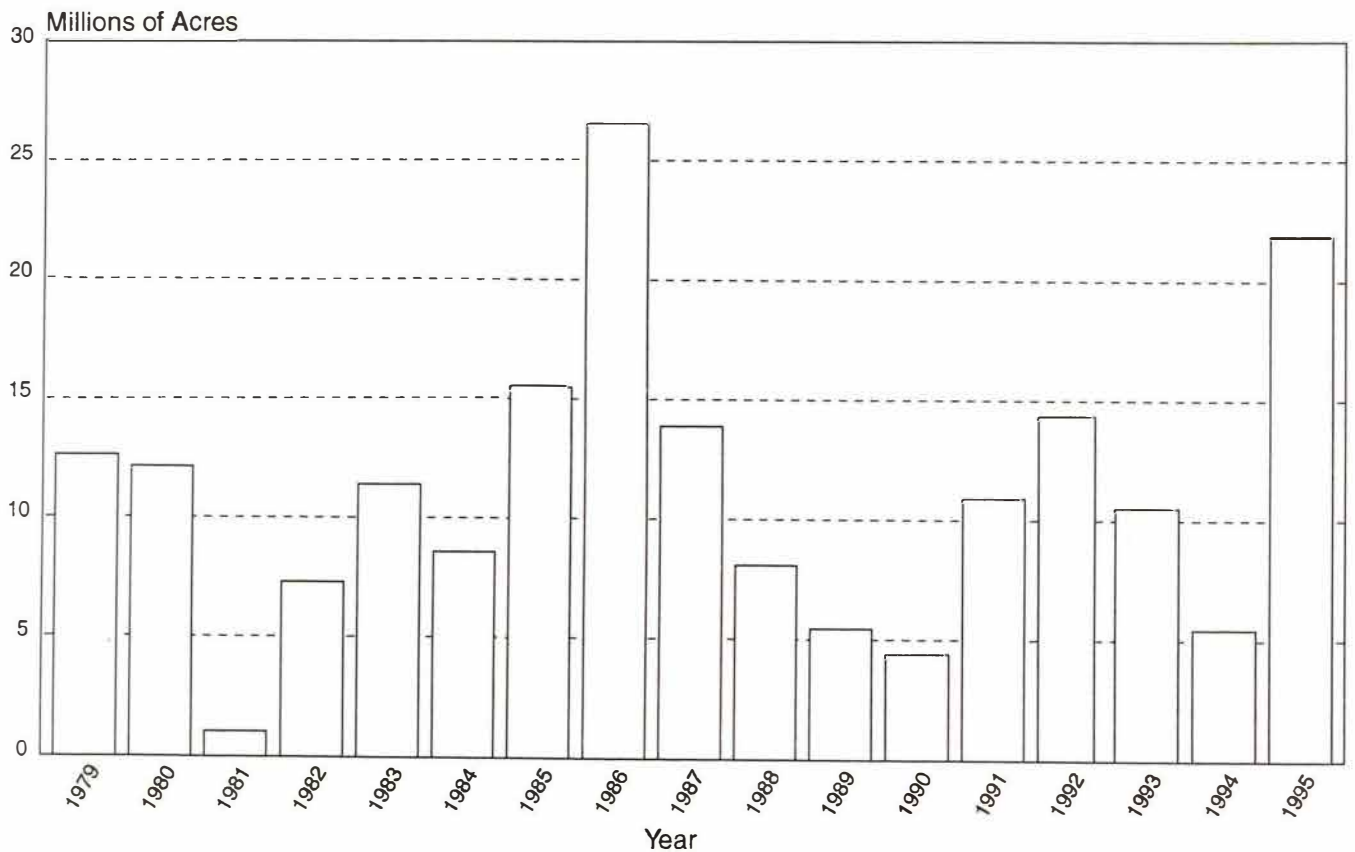


Acres (in thousands) of Southern Pine Beetle Outbreaks in Southern Region (R-8), 1991–1995*

State	1991	1992	1993	1994	1995
Alabama	3,937.1	5,815.7	2,753.4	2,951.4	6,552.4
Arkansas	0.0	55.8	649.1	429.6	2,112.9
Georgia	346.5	871.0	587.3	315.4	1,326.0
Florida	0.0	0.0	0.0	97.1	736.0
Kentucky	0.0	0.0	0.0	0.0	0.0
Louisiana	1,197.6	3,112.4	2,291.9	0.0	2,908.8
Mississippi	1,278.4	406.1	331.5	689.6	2,714.3
North Carolina	40.1	334.3	569.6	47.9	2,755.6
Oklahoma	0.0	0.0	0.0	0.0	0.0
South Carolina	2,413.6	469.2	366.4	332.8	2,542.9
Tennessee	0.0	45.9	173.0	148.6	0.0
Texas	1,495.9	2,663.3	1,106.8	238.3	0.0
Virginia	35.0	533.6	1,584.6	0.0	27.0
Total	10,744.2	14,307.3	10,413.6	5,250.7	21,675.9

*Acres of outbreak are acres of host type having one or more multi-tree spots per 1,000 acres.

Acres of Southern Pine Beetle Outbreaks in Southern Region (R-8), 1979–1995.



Insect Conditions Highlights

Mountain pine beetle (*Dendroctonus ponderosae*) is a native bark beetle that attacks lodgepole, ponderosa, sugar, western white, and other pines. The beetle ranges throughout western pine forests from Canada into Mexico. Beetles infest mature lodgepole pine and both mature and overstocked stand of other pines.

Tree mortality increased in 1995 as well as acreages

affected, indicating that beetle populations may be increasing. In Colorado, beetle populations appear to be building in ponderosa pines heavily defoliated by pine tussock moth in 1993. Some lodgepole pines defoliated by lodgepole needle miner are being killed in California.

Very small, scattered infestations are not included in the table or map below.

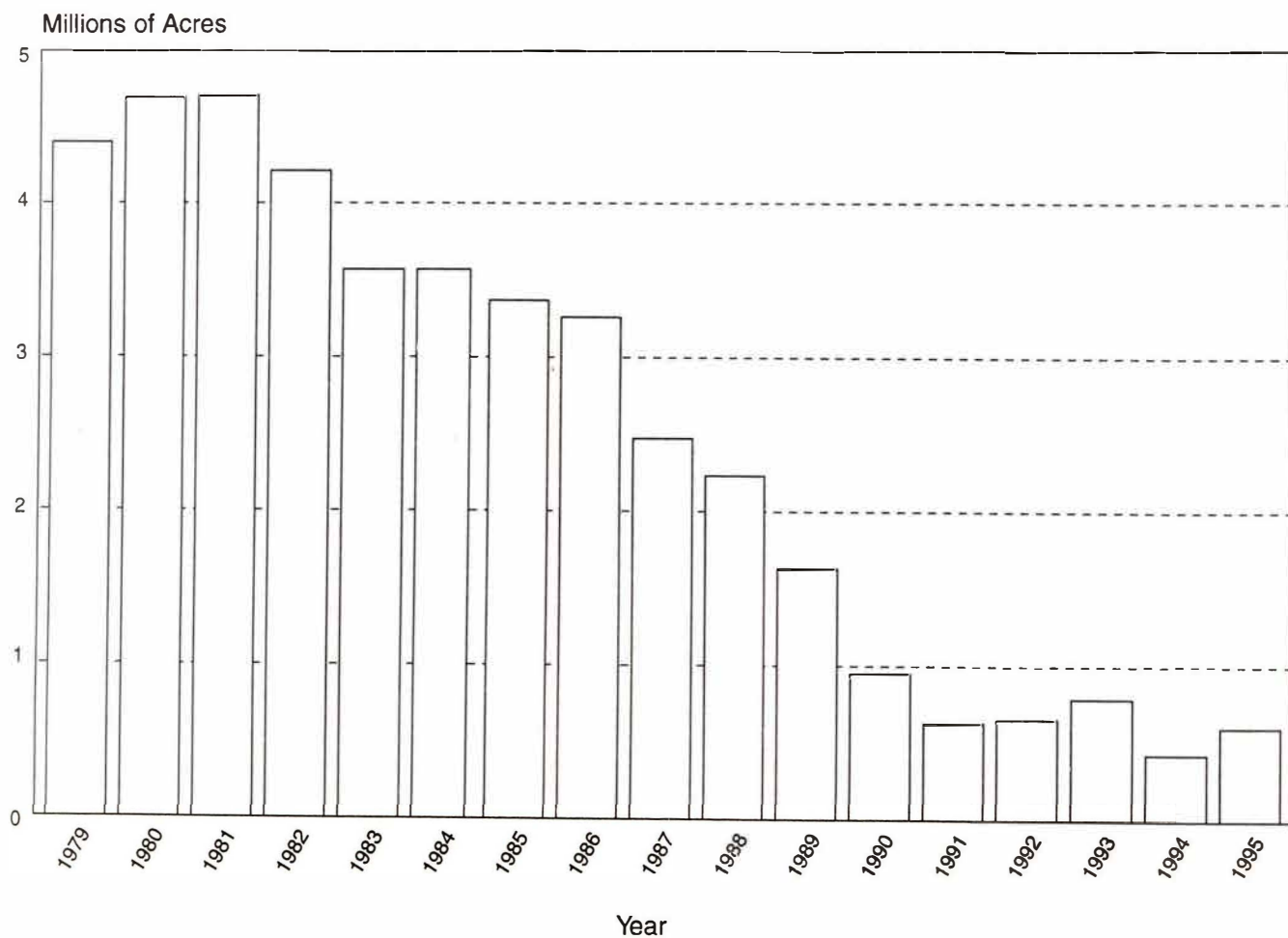
Mountain Pine Beetle Outbreak Areas, 1995



Acres (in thousands) of Mountain Pine Beetle Outbreak, 1991–1995

State	1991	1992	1993	1994	1995
Arizona	0.0	0.0	0.0	0.2	0.2
California	---	---	121.0	115.0	58.9
Colorado	1.5	0.0	0.0	1.2	4.7
Idaho	22.5	22.4	43.7	7.8	13.9
Montana	160.0	65.9	43.4	19.2	31.3
New Mexico	1.4	1.2	1.4	2.8	0.4
Oregon	249.6	303.0	345.6	161.1	234.4
South Dakota	10.0	13.6	13.6	1.4	2.6
Utah	1.3	4.1	10.0	18.7	20.9
Washington	155.4	125.2	200.3	76.4	205.9
Wyoming	15.4	106.0	2.8	1.6	2.3
Total	617.1	641.4	781.8	405.4	575.5

Mountain Pine Beetle Infestations, 1979–1995.



Insect Conditions Highlights

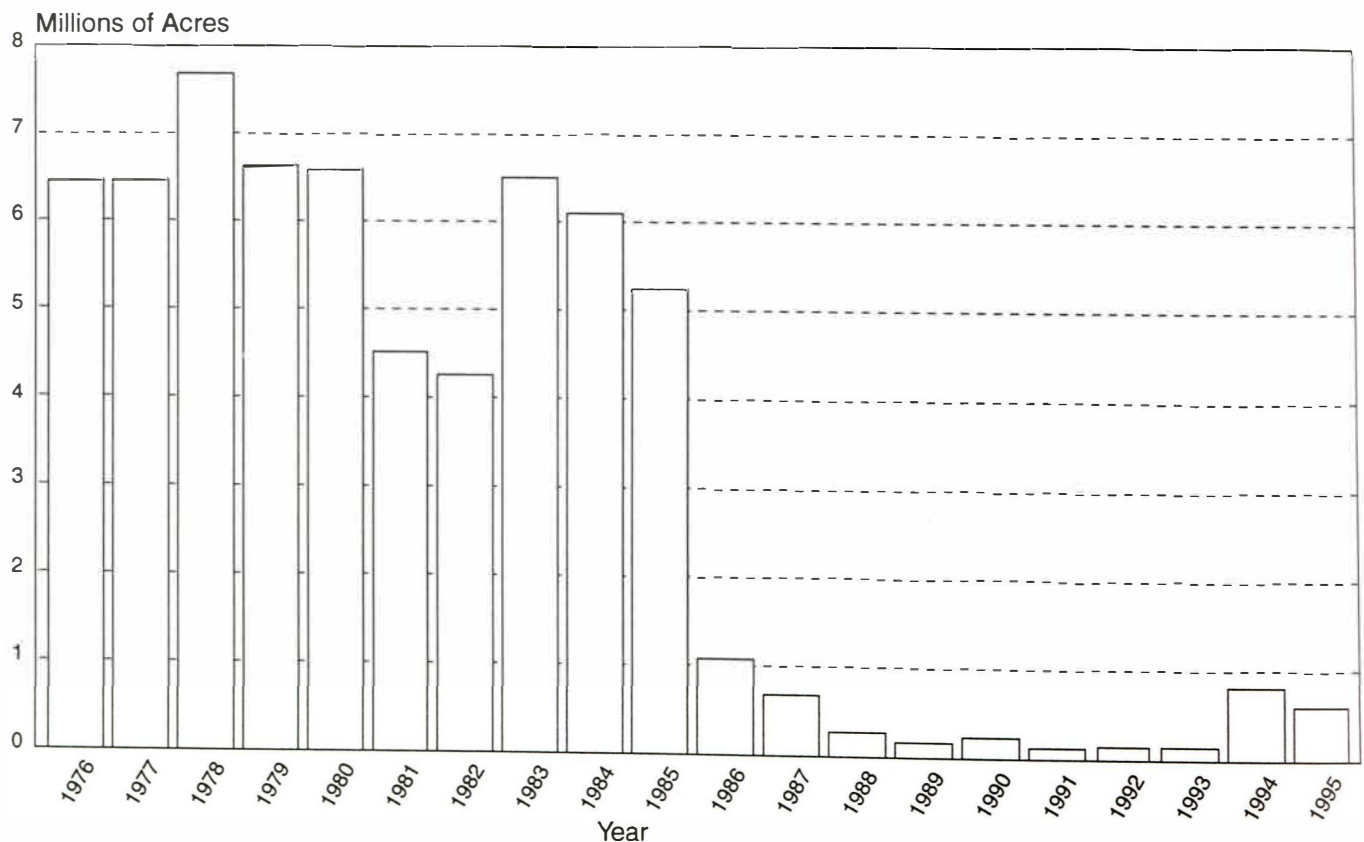
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In the Northeast and the Great Lakes, the acreage defoliated remains low following the outbreaks of the

late 1970's and early 1980's. Nevertheless, more than 500,000 acres of trees were defoliated in Minnesota in 1995, and budworm-caused defoliation has reappeared in Michigan, New York, and Wisconsin.

In Alaska, however, some areas have experienced five consecutive years of budworm defoliation by *C. fumiferana* var. *orae*, and var. *biennis*. Some top kill and tree mortality is occurring. The acreage defoliated increased from 232,500 acres in 1994 to 279,000 acres in 1995.

Counties Where Spruce Budworm Defoliation Reported in Eastern United States, 1995



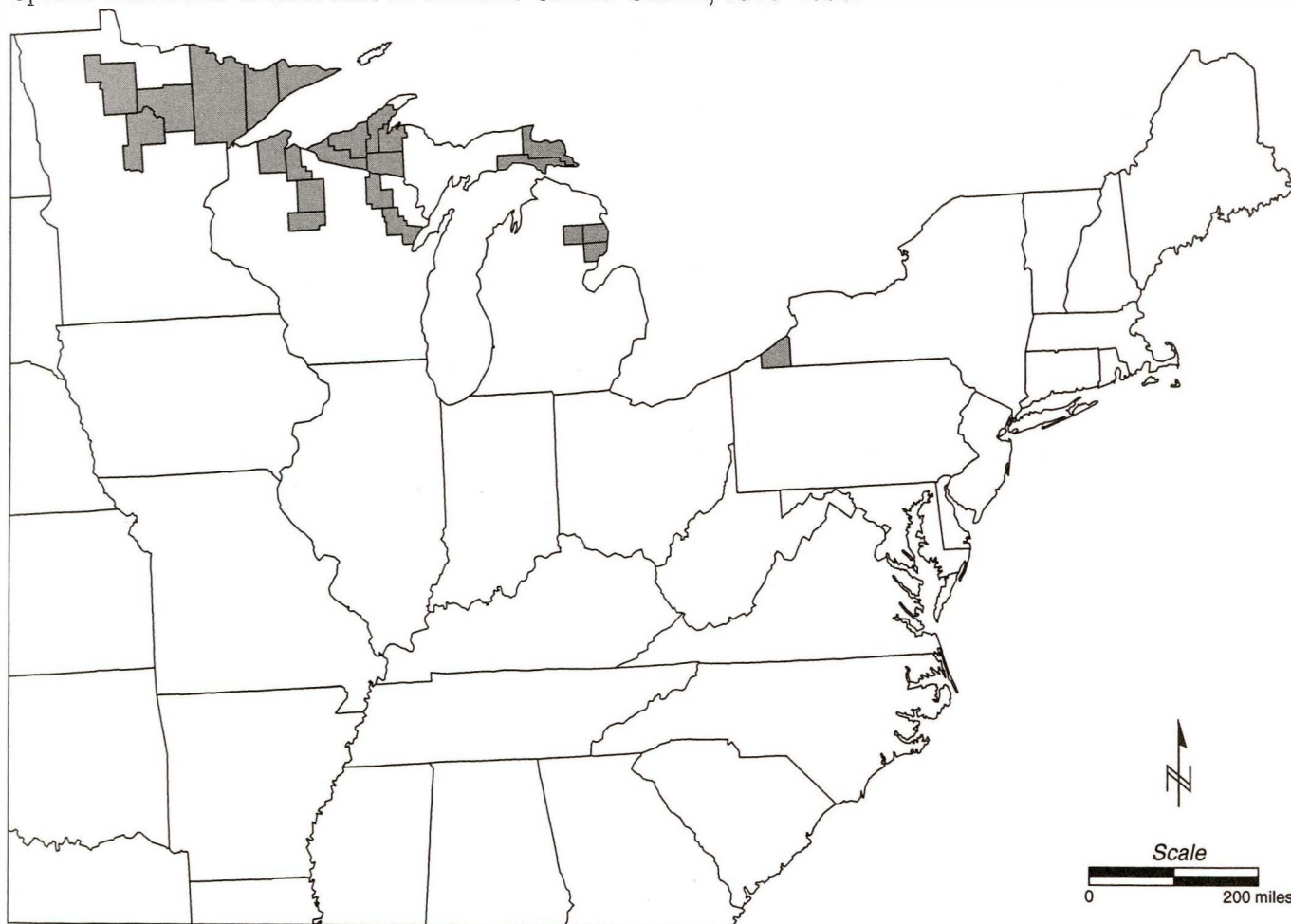
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Maine	0.0	0.0	0.0	0.0	0.0
Michigan	0.0	0.0	0.0	6.8	51.2
Minnesota	108.0	126.0	116.0	770.5	505.0
New Hampshire	0.0	0.0	0.0	0.0	0.0
New York	0.0	0.0	0.0	0.1	0.4
Vermont	0.0	0.0	0.0	0.0	0.0
Wisconsin	0.0	0.0	0.0	1.0	12.5
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Acres (in thousands) of Aerially Detected Spruce Budworm in Alaska, 1991–1995

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Spruce Budworm Defoliation in Eastern United States, 1976–1995.



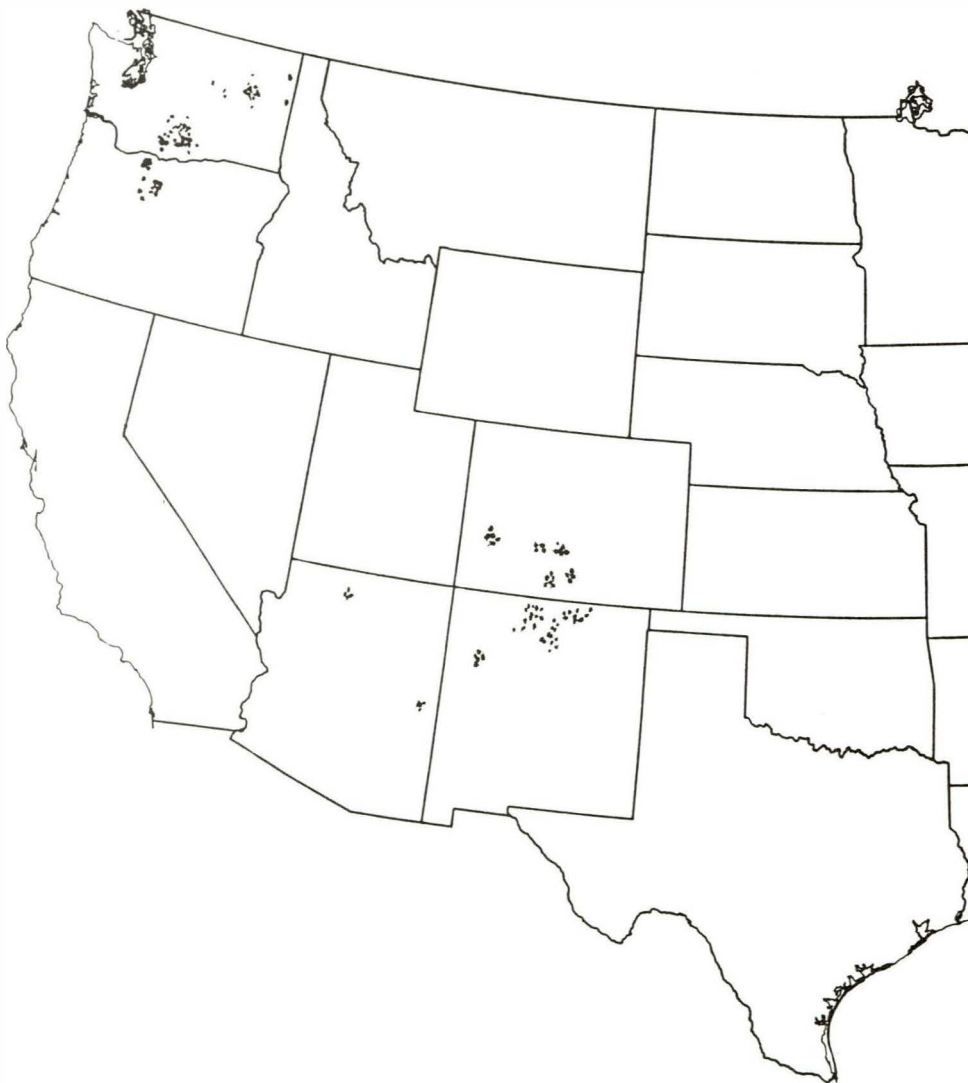
Insect Conditions Highlights

Western spruce budworm (*Choristoneura occidentalis*) defoliation remains generally low throughout the West. No budworm defoliation was observed in Montana and Idaho for the first time since aerial surveys began in 1948. Also, no defoliation was observed in the Intermountain Region for the second consecutive year. However, in Colorado tree mortality is occurring in some areas repeatedly defoliated over the past decade.

Some activity was observed in Arizona and New Mexico. About 190,000 acres were defoliated in the Pacific Northwest, an increase of 67,000 acres.

Epidemics cause reduced growth, tree deformity, top kill, and tree mortality on extensive areas. Trees weakened by defoliation are often predisposed to attack by bark beetles.

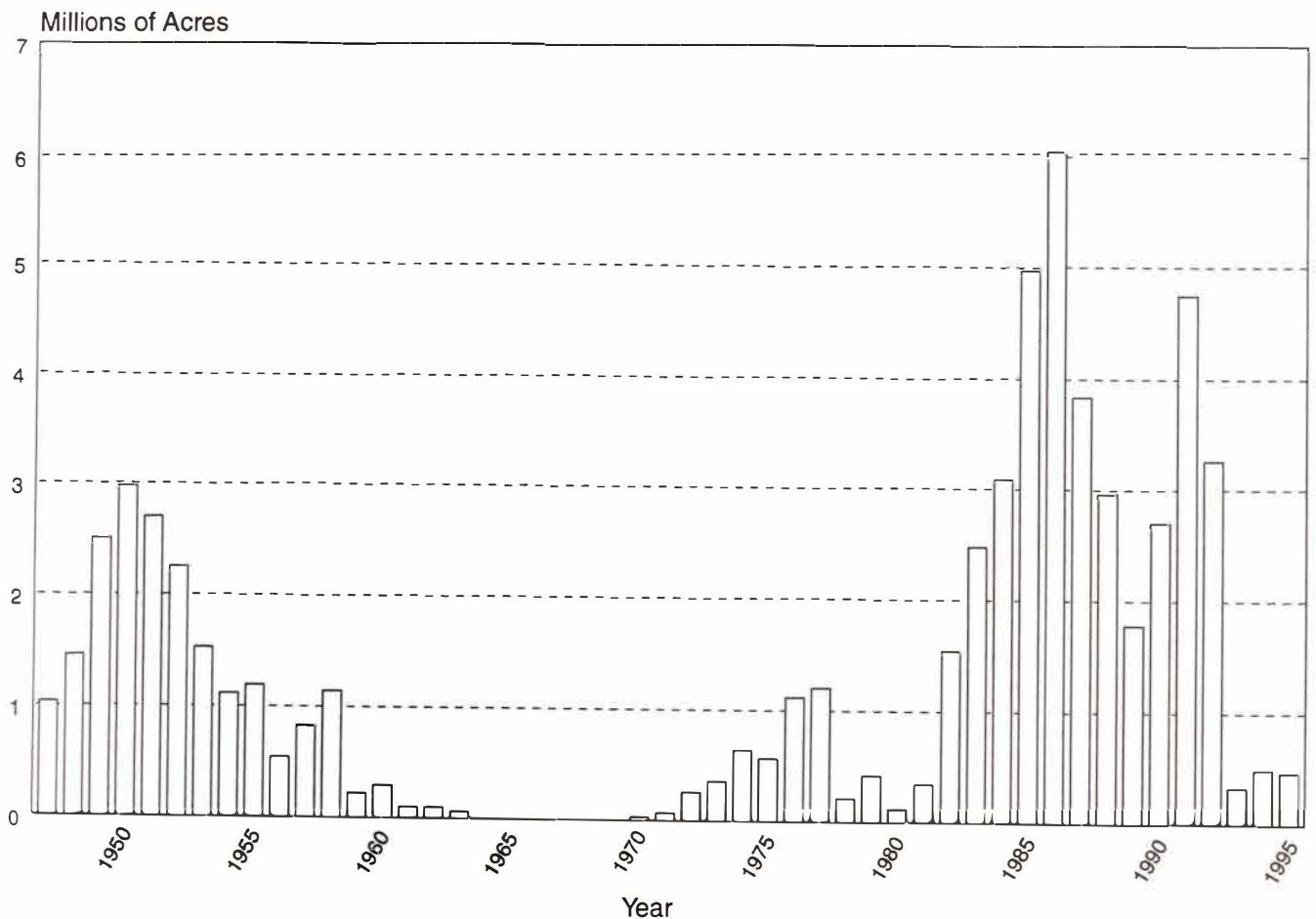
Western Spruce Budworm Defoliation Areas, 1995



Acres (in thousands) of Aerially Detected Western Spruce Budworm Defoliation, 1991–1995

State	1991	1992	1993	1994	1995
Arizona	0.0	11.5	0.0	0.0	7.0
California	0.0	0.0	0.0	0.0	0.0
Colorado	509.0	272.2	1.2	0.0	97.0
Idaho	61.5	89.8	0.9	0.0	0.0
Montana	1,595.7	941.3	44.2	2.4	0.0
New Mexico	218.6	9.4	66.4	369.2	183.8
Oregon	3,724.9	1,937.7	87.7	37.4	14.9
Utah	0.0	0.0	0.0	0.0	0.0
Washington	1,027.7	1,329.5	243.8	85.4	175.1
Wyoming	33.5	2.5	2.5	1.1	0.0
Total	7,170.9	4,593.9	446.7	495.5	477.8

Western Spruce Budworm Defoliation in Pacific Northwest Region (R-6), 1947–1995.



Hemlock woolly adelgid (*Adelges tsugae*) was reported on the West Coast in the 1920's, probably imported from Asia. The adelgid does very little damage in western forests, but sometimes kills ornamental trees.

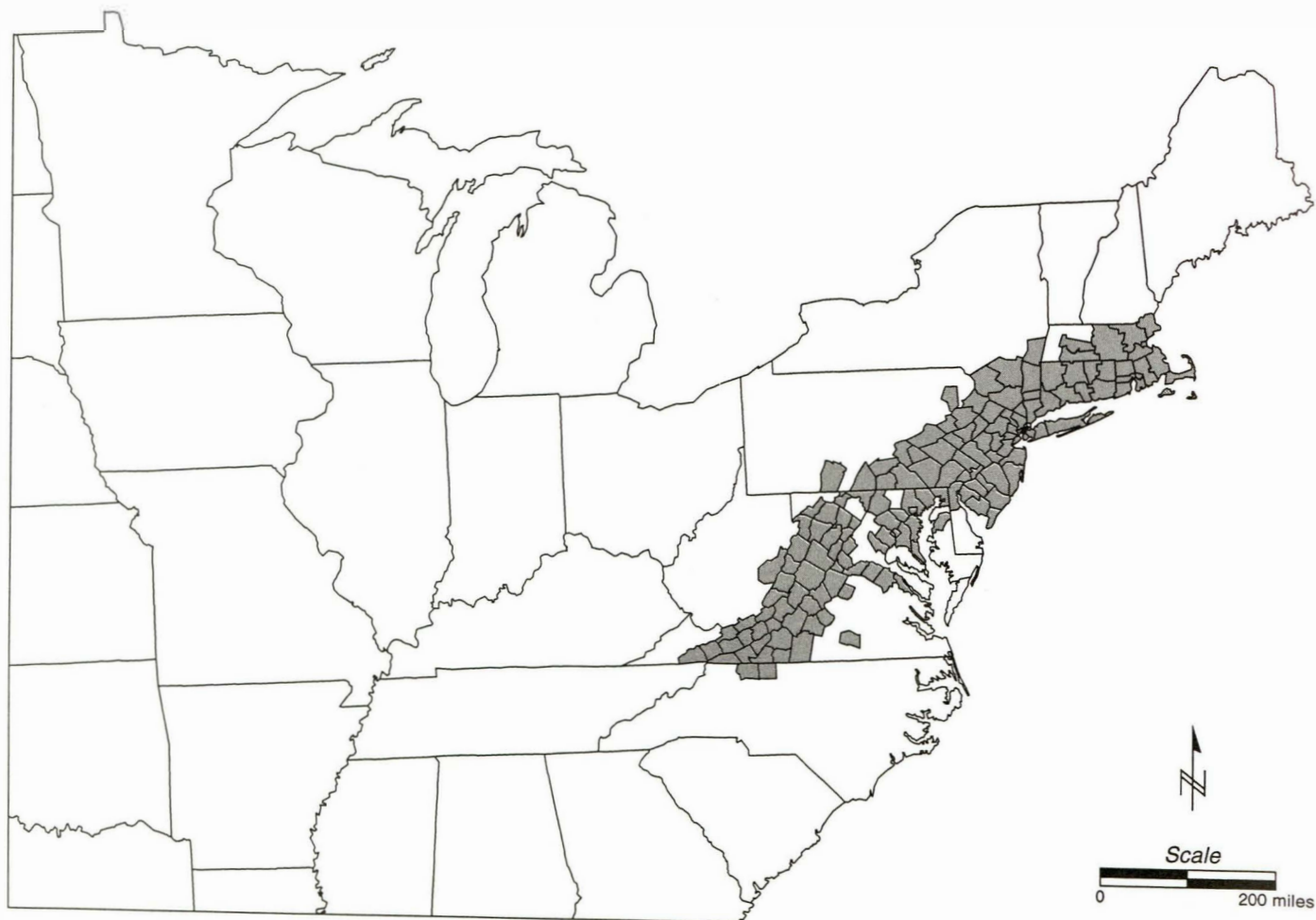
However, the hemlock woolly adelgid poses a serious threat to the eastern hemlock. The adelgid can kill eastern hemlock trees in 3 to 5 years. In 1950 the insect was introduced into the East Coast near Richmond, Virginia, and has spread north into southern New England; new infestations are being found in Massachusetts, Rhode Island, and Connecticut.

In Virginia, hemlocks are infested, except for those in

the southwestern counties, and decline and mortality are extensive. In 1995, infestations were found in two counties in North Carolina; the first report of the insect in that state.

The eastern hemlock has important aesthetic qualities in scenic areas, campgrounds, and recreation areas. The loss of eastern hemlock from stream banks is a threat to trout because shade from the tree limbs help maintain cool water temperatures.

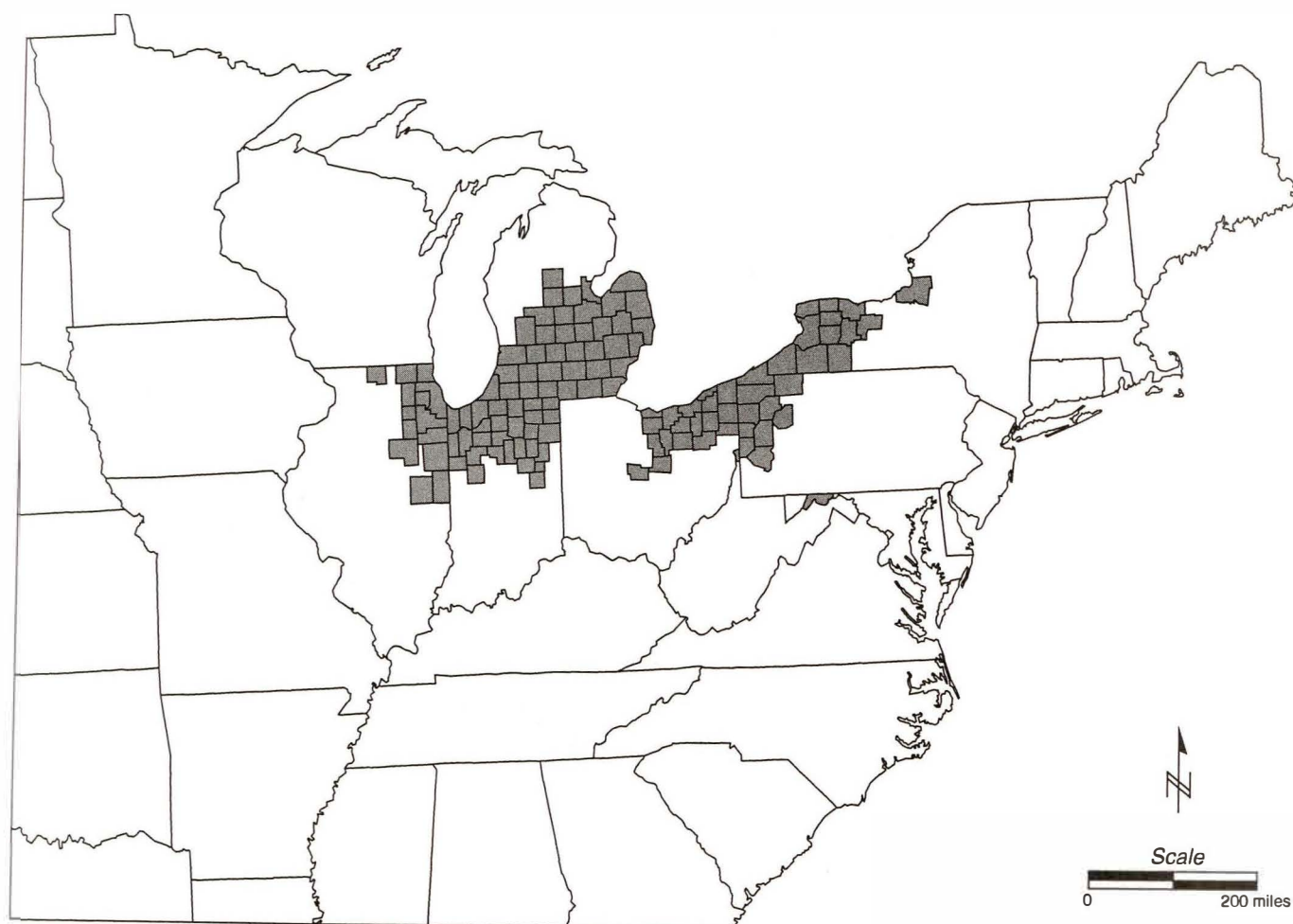
Counties Where Hemlock Woolly Adelgid Reported, 1995



Common European pine shoot beetle (*Tomicus piniperda*) is an introduced insect discovered near Cleveland, Ohio, in 1992. In April 1995, beetles were found in Allegany County, Maryland, and Hancock County, West Virginia, adding those two states to the list of six—Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania. The beetle continued to spread within these states in 1995. The beetle has also been found in ten counties in Ontario, Canada.

The beetle prefers Scotch pine but feeds on other pines as well. Thus far, the beetle is a problem mainly for Christmas tree growers. A native of Europe and Siberia, the beetle causes serious damage to trees in burned over areas and areas experiencing severe drought. Because of the damage potential to trees in the United States, infested counties have been placed under state and federal quarantine to prevent movement of this beetle to new areas. In 1994, Mexico set a quarantine on shipment of Christmas trees from infested counties into Mexico.

Counties Where Common European Pine Shoot Beetle Reported, 1995



Insect Conditions Highlights

Spruce beetle (*Dendroctonus rufipennis*) is a native insect that occurs across northern North America and south in the Rocky Mountains to Arizona. Spruce beetle is the most significant mortality agent of mature spruce. Beetle populations also build up in windthrown trees. Besides killing merchantable trees, infestations affect habitat quality for wildlife and fish, reduce scenic quality, and increase fire hazard and long-term ecosystem conversion.

The infestations in Alaska reached the highest level in history in 1995. More than 892,800 acres are infested; up 40 percent from the 641,000 acres reported in 1994. The outbreak is largely on state and private lands.

Infestations are generally low in the western states. In many cases the acreage of susceptible host type has declined due the gradual removal of preferred host trees by previous infestations and by wildfires.

Spruce Beetle Areas in Alaska, 1995



Disease Conditions Highlights

Root disease fungi, especially those causing annosus root disease (*Heterobasidion annosum*) and armillaria root disease (*Armillaria* spp.), occur through the United States and influence management options available to land managers. Damage has increased greatly over the last century because of altered forest conditions and structure due to fire control and past management practices.

Annosus root disease is common in the West, causing varying degrees of root and butt rot in conifer stands and contributing to significant tree mortality. The disease predisposes trees to windthrow and bark beetle attack. In the South, annosus root disease is significant in pine plantations, especially those where trees have been thinned. Bark beetle infestations often occur in diseased stands.

Armillaria root disease is a major cause of mortality in ponderosa pine stands and affects other conifers as well. The disease is more troublesome in connection with bark beetle activity.

White pine blister rust is an introduced fungus (*Cronartium ribicola*) that was first found in New York in 1906, arriving on white pine nursery stock from

Germany. The disease has spread throughout the range of eastern white pine and has changed the way eastern white pine is managed in many areas.

The disease was also introduced into western North America, arriving on white pine nursery stock imported from France; it was first found in British Columbia in 1921. The disease has spread throughout much of the West, affecting western white pine, sugar pine, and to some extent high-elevation five-needle pines, and causing significant tree mortality. In 1990, the disease was found affecting southwestern white pine in New Mexico, where in 1995 about one-half million acres were affected.

Fusiform rust (*Cronartium quercuum* f. sp. *fusiforme*), a native fungus, continues to be the most damaging disease agent of loblolly and slash pines in the South. An estimated 13.5 million acres of pines are affected. Acres are classified as affected if more than 10 percent of the trees have potentially lethal cankers. Georgia is the most seriously affected state, with 4.6 million acres (49 percent), of host type affected. A revised method used in 1993 for analyzing infection data from previous years' surveys precludes making comparisons to previous conditions reports.

Acres (in thousands) Affected by Fusiform Rust, 1995*

State (survey year)	National Forest System	Other Federal	State and Private	Total
Alabama (90)	7.1	0.0	1,704.2	1,711.3
Arkansas (88)	0.0	0.0	166.9	166.9
Florida (87)	20.8	9.8	1,135.9	1,166.5
Georgia (89)	38.0	102.8	4,452.9	4,593.7
Louisiana (91)	85.0	18.4	1,554.9	1,658.3
Mississippi (87)	121.2	0.0	1,147.9	1,269.1
North Carolina (90)	4.9	7.8	956.2	968.9
Oklahoma (92)	0.0	0.0	33.9	33.9
South Carolina (95)	45.6	58.8	1,332.2	1,436.6
Texas (92)	21.8	0.0	397.3	419.1
Virginia (92)	0.0	0.0	59.3	59.3
Total	344.4	197.6	12,941.6	13,483.6

* Acres with greater than 10 percent infection.

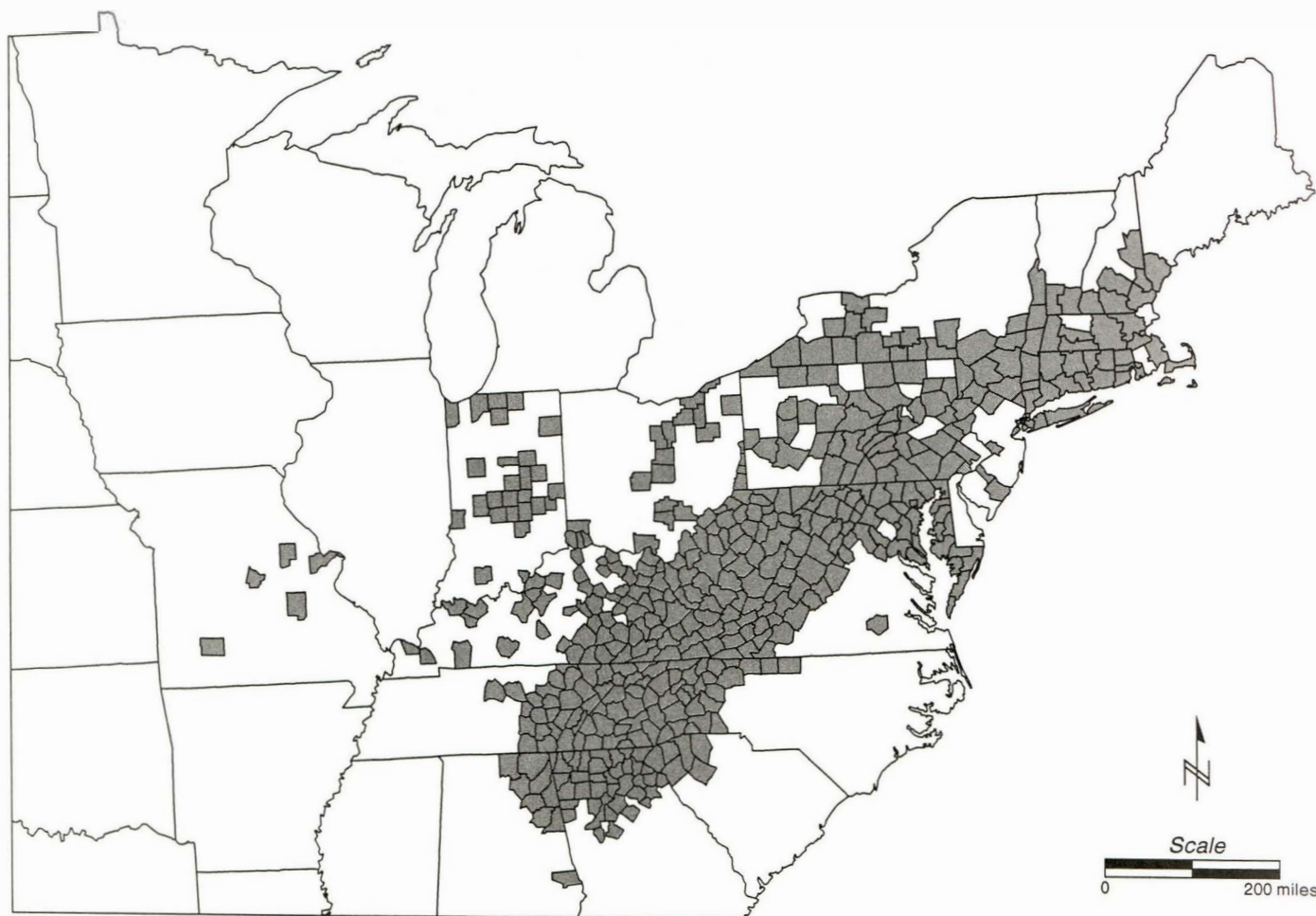
Dogwood anthracnose is caused by a fungus (*Discula destructiva*) of unknown origin. The fungus may have been introduced or a previously innocuous fungus may have become a significant pathogen. The disease was first discovered in the Pacific Northwest in 1976. It is now confirmed in Idaho, Oregon, and Washington.

In the East, the fungus was first found in southeastern New York in 1978. By 1987, it was found in nine eastern states from Massachusetts to Georgia, and by 1994 it was confirmed in 21 states from Maine to Alabama and west as far as Indiana and Missouri. Infected nursery shipments are implicated in this most recent western spread, but in Indiana at least, native stands

are now infected. The range of dogwood extends from southern Maine to Florida and west to Michigan and eastern Texas. The disease affects both woodland and ornamental dogwoods. In the South, damage is most severe at higher elevations and in cool, moist areas in lower elevations. Control measures are available for ornamental trees but are not practical in the general forest.

Although the Pacific dogwood is more susceptible than the eastern dogwood, drier summers in the West reduce the number of infection cycles. Thus, although significant mortality has occurred in the Pacific Northwest, the problem is not as severe as it is in the East.

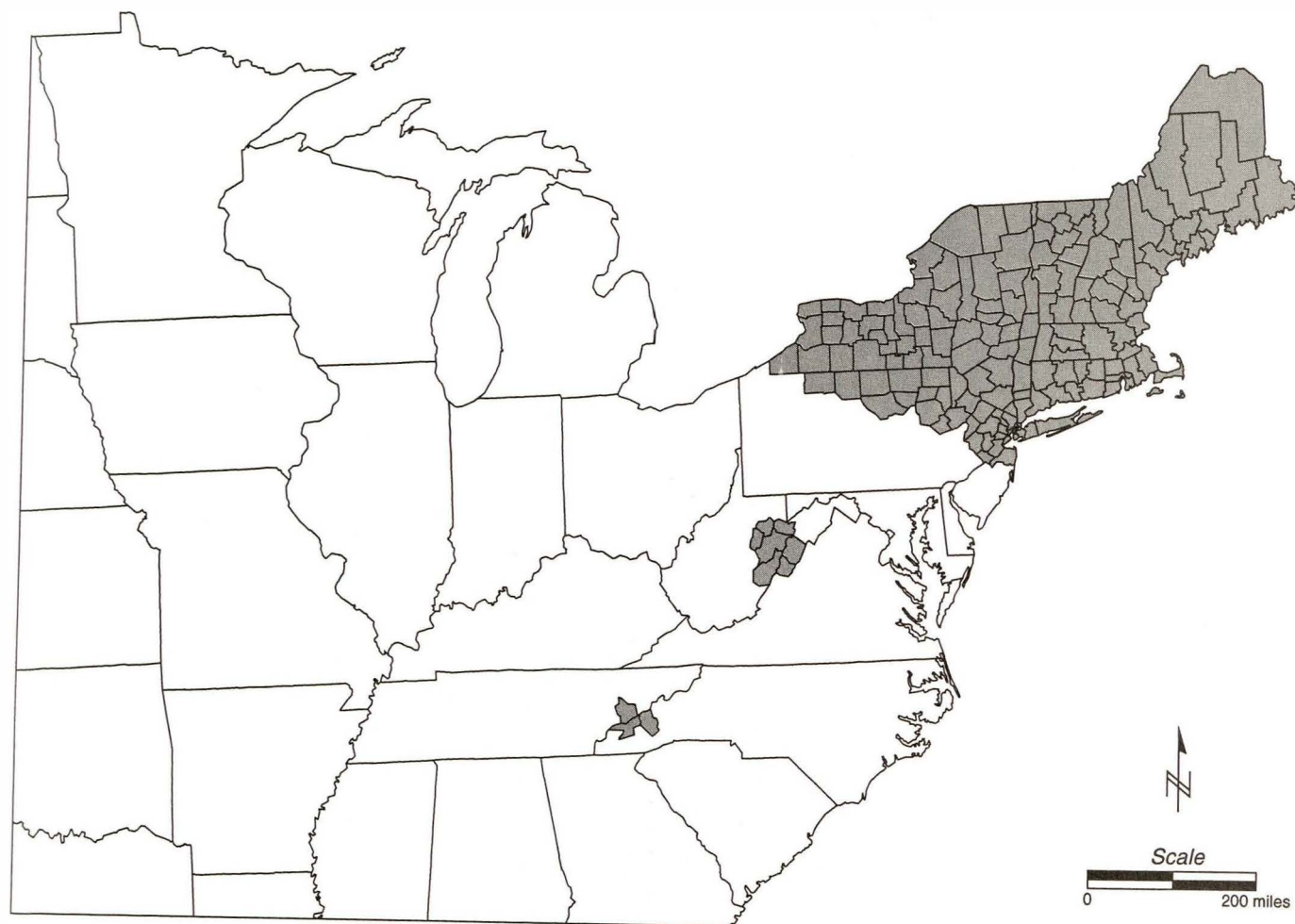
Eastern Counties Where Dogwood Anthracnose Reported, 1995



Beech bark disease is the result of an attack by the beech scale, *Cryptococcus fagisuga*, followed by the invasion of several species of *Nectria* fungi. About 1890, the scale was accidentally introduced into eastern Canada. By 1932, the disease was killing trees in Maine and, by 1981, had spread to West Virginia. In 1994 the disease was found affecting approximately 100 acres

on the North Carolina–Tennessee border, about 300 miles southwest of its previously known distribution. This area of infestation increased in size in 1995. The range of American beech is from Maine to northwestern Florida west to the eastern parts of Wisconsin and Texas. Considerable beech mortality has occurred in the Northeast south to Pennsylvania.

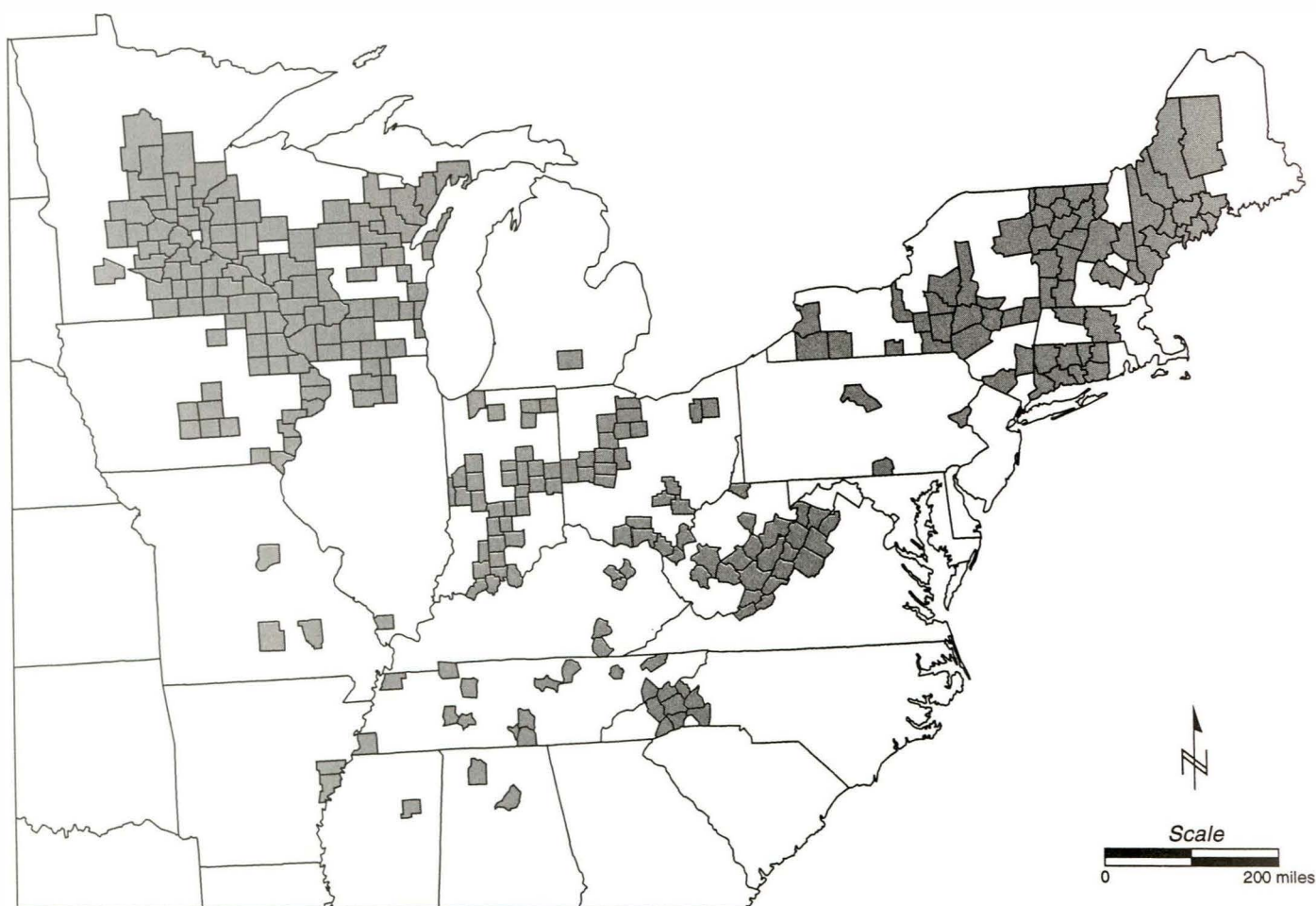
Counties Where Beech Bark Disease Reported, 1995



Butternut canker is caused by the fungus *Sirococcus clavigignenti-juglandacearum*. The origin of this fungus is unknown. Symptoms of the disease have been recognized since the early 1900's, but the causal fungus was not identified until the late 1970's. The range of butternut is from Maine to Georgia on the east, then west to Minnesota and Arkansas. The disease

is found throughout most of the range and is a serious threat to the survival of the species. In the Southeast, 77 percent of the trees are already dead. The Forest Service and some states have imposed a moratorium on harvesting healthy trees in the hopes of finding resistant stock. There are no known control measures.

Counties Where Butternut Canker Reported, 1994



Dwarf mistletoes (*Arceuthobium* spp.) are parasitic plants that invade the branches of host trees. This disease is associated with much of the tree mortality in the West. Conifers on about 29 million acres of western forests are infected. The disease reduces tree growth and seed crops, kills tops, branches, and entire trees. About 180 million cubic feet of wood are lost annually. Most of the volume loss is caused by 7 of the 19

dwarf mistletoe species: those on Douglas-fir, lodgepole pine, true fir, western hemlock, western larch, and 2 species on ponderosa pine.

In the past, forest fires helped reduce the incidence of dwarf mistletoes. The advent of fire control has had the inadvertent effect of allowing dwarf mistletoes to increase in severity.

Acres (in thousands) in the West Affected by Dwarf Mistletoes, 1995

State (survey year)	National Forest System	Other Federal	State and Private	Total
Alaska *	3,060.0	0.0	340.0	3,400.0
Arizona (85-89)	1,040.0	674.0	25.0	1,739.0
California (80-90)	2,276.0	69.0	1,911.0	4,256.0
Colorado (79,82)	638.0	---	---	638.0
Idaho, North (70-80) **	478.0	10.0	224.0	712.0
Idaho, South (94) **	2,961.6	---	---	2,961.6
Montana (70-80)	1,694.0	123.0	600.0	2,417.0
New Mexico (85-89)	1,140.0	348.0	581.0	2,069.0
Nevada (94)	58.9	---	---	58.9
Oregon (67)	2,703.0	505.0	2,470.0	5,678.0
Utah (94)	432.2	---	---	432.2
Washington (76)	1,137.0	43.0	2,760.0	3,940.0
Wyoming (94)	605.3	---	---	605.3
Total	18,224.0	1,772.0	8,911.0	28,907.0

*Commercial acreage only in Alaska. Data based on years of knowledge of the resource and the disease.

**Idaho North is in Region 1, and Idaho South is in Region 4.

Part 2

Conditions by Damage Agent by Region

Insect Conditions by Region

Insects: Native

Cherry scallop shell moth, *Hydria prunivorata*

Region 9/Northeastern Area:
Michigan, New Hampshire,
New York, Ohio, Pennsylvania,
Vermont, West Virginia

Host(s): Black cherry, pin cherry

The acreage defoliated by the cherry scallop shell moth increased from 321,800 acres in 1994 to approximately 924,956 acres of cherry forests in Michigan, New Hampshire, New York, Ohio, Pennsylvania, and West Virginia. Pennsylvania alone accounted for 654,218 of those acres. This is almost a three-fold increase in the number of acres of defoliation reported in 1994. In Vermont, cherry scallop shell moth was observed, but no significant defoliation reported.

Cypress looper, *Anacamptodes pergracilis*

Region 8: Florida, Texas

Host(s): Baldcypress and pondcypress

The cypress looper is an infrequent pest of baldcypress and pondcypress trees of all ages in a few locales throughout the southeastern United States. An outbreak of this multivoltine (having several broods in a season) defoliator, which began in 1994, increased in area and intensity during 1995. An aerial survey in Florida in October revealed over 450,000 acres of noticeable defoliation, spread across portions of five counties (Charlotte, Collier, Glades, Hendry and Lee). An additional 100,000 acres of defoliation was reported in the Big Cypress National Preserve. High looper populations were evident in virtually all cypress stands from Lake Okeechobee south through Everglades National Park (Dade and Monroe Counties) and west to the coastline. Previous outbreaks of this insect were recorded in similar locales during 1980-81 and 1972, with little if any resulting cypress mortality.

The cypress looper defoliated 300-400 acres of cypress on Caddo Lake in northeast Texas in August. This was the first report of this pest in Texas. No control action was taken.

Douglas-fir beetle,
Dendroctonus pseudotsugae

Region 1: Idaho, Montana,
Wyoming

Host(s): Douglas-fir

Acres infested by the Douglas-fir beetle increased in region 1 from 9,600 acres in 1994, to nearly 21,000 acres in 1995. The most significant increases occurred in stands throughout northern Idaho, as a result of extremely warm and dry weather in 1994. There was a slight decrease in infested area in western Montana, although the extensive fires in 1994 enabled beetles to maintain populations in some areas. Aggressive salvage of fire-weakened and infested trees should help keep beetle populations from expanding significantly in 1996.

Region 2: Colorado, Wyoming

Host(s): Douglas-fir

Douglas-fir beetle is active in many areas throughout Colorado, but activity tends to be widely scattered. Much of this activity is associated with western spruce budworm defoliation. Of note in 1995 was scattered mortality from Bayfield to Pagosa Springs on the San Juan National Forest. Mortality is expected to continue in these areas, although Douglas-fir beetle is not expected to achieve epidemic status. Mortality along the Colorado Front Range continues to occur in small, widely scattered groups. Most mortality is on steep inaccessible slopes where western spruce budworm has defoliated trees over the past decade. Additional mortality is occurring in areas heavily defoliated in the past 3 years by the Douglas-fir tussock moth. On the Shoshone National Forest in Wyoming, the epidemic continued to spread on the Clarks Fork and Wapiti Ranger Districts. About 4,500 trees were killed in 1995 between Sunlight Basin and Crandell Ranger Station and between Wapiti and Pahaska. The epidemic is expected to continue into 1996.

Region 3: Arizona, New
Mexico

Host(s): Douglas-fir

Douglas-fir beetle-caused tree mortality decreased slightly throughout region 3, from 695 acres in 1994 to 570 acres in 1995. Mortality occurred on the Apache-Sitgreaves National Forests (240 acres), Coconino National Forest (140 acres), Kaibab National Forest (150 acres), and the Fort Apache Indian Reservation (40 acres) in Arizona. No Douglas-fir beetle activity was noted on federal lands in New Mexico.

Region 4: Idaho, Utah,
Wyoming

Host(s): Douglas-fir

Regionwide mortality decreased slightly, with 48,500 trees killed in 1995. Outbreaks were located on the Boise, Sawtooth, and Payette National Forests in southern Idaho. In Utah, tree mortality increased with 6,700 trees killed in 1994 and 11,500 trees killed in 1995. The largest outbreaks are located on the Manti-LaSal, Uinta, and Wasatch-Cache National Forests. Smaller outbreaks are located on other national forests in Utah. Mortality on the Bridger-Teton National Forest in western

Wyoming decreased from 6,400 trees killed in 1994 to 2,000 trees killed in 1995.

Region 5: Northern California Host(s): Douglas-fir

Few attacks by Douglas-fir beetle were reported. The greatest concentration was found along the upper Sacramento River between Lake Siskiyou and Gumboot Lake.

Region 6: Oregon, Washington Host(s): Douglas-fir

Douglas-fir beetle occurs throughout the range of Douglas-fir and is considered the most important bark beetle that causes mortality in Douglas-fir. Normally it breeds in felled, injured, or diseased trees. The females bore into the bark and tunnel upward through the phloem. Eventually, girdling of the sapwood and clogging of the conductive tissues by fungi introduced by the beetles can result in mortality. The resulting mortality is widely scattered when at low levels. At times, the insect reaches epidemic levels and kills apparently healthy trees over extensive areas.

Douglas-fir beetle activity decreased throughout region 5, from 73,700 acres averaging 0.83 tree per acre in 1994 to 44,200 acres with an average of 0.59 tree per acre in 1995. The Umatilla and Wallowa-Whitman National Forests experienced the most significant increases in observed activity. High levels of mortality in the Blue Mountains are due, in part, to tree stress caused by repeated years of defoliation by western spruce budworm, drought, and overstocking. The greatest problem appears to be in riparian areas that have dense concentrations of large, old trees. High populations of Douglas-fir beetle and the resultant host mortality in the Blue Mountains are expected to continue for the next few years.

Douglas-fir tussock moth, *Orgyia pseudotsugata*

Region 1: Idaho, Montana Host(s): Douglas-fir, spruce, true firs

Douglas-fir tussock moth populations remained at extremely low levels in 1995. No aerially visible defoliation was detected nor were any larvae found at those sites that were sampled. Moth catches in pheromone traps were at record low levels in Idaho and at very low levels in Montana. Populations are expected to remain quite low in 1996.

Region 2: Colorado Host(s): Douglas-fir

Heavy defoliation declined from 6,134 acres in 1994 to 1,491 acres in 1995 on the South Platte River drainage of the Pike National Forest. This is the first epidemic of such size in Colorado. Some additional defoliation is expected in 1996. Activity occurred as a "halo" around one population

Insects: Native

center, while the other, older center showed little to no activity. Evidence indicates that this pattern is typical for the species elsewhere in its range. An early warning system using pheromone traps was installed and will be continued. Results for 1995 detected no additional areas of concern.

Region 4: Idaho, Utah

Host(s): Douglas-fir, true firs

No defoliation was observed in 1995.

Region 5: Northern California

Host(s): White fir

Male moth catches from monitoring traps throughout northeastern California indicates a general increase in the number of male moths caught compared to 1994. Egg mass surveys are planned for the winter and larval surveys will be conducted in the spring of 1996.

Trap catches on the Eldorado and Stanislaus National Forests showed consistent, substantial increases. Numbers from 2 of 10 plots on the Sierra National Forest also increased.

Region 6: Oregon, Washington

Host(s): Douglas-fir, true firs

The tussock moth can eat foliage of several tree species, but only three are considered primary hosts: Douglas-fir, grand fir, and white fir. Newly hatched and early instar larvae feed on current year's foliage freshly flushed from elongating shoots. Later instar larvae feed on all foliage.

Detection of tussock moth-related defoliation fell to 2,900 acres in 1995, down from 26,500 acres reported in 1994. Most of the defoliation was reported on the Burns Ranger District of the Malheur National Forest. Further declines are expected in 1996.

Elm spanworm, *Ennomos subsignarius*

Region 9/Northeastern Area:
New York, Pennsylvania

Host(s): Sugar maple

In Pennsylvania, only 30,000 acres were defoliated by the elm spanworm in 1995. This is down considerably from the 1.2 and 1.6 million acres of defoliation in 1993 and 1994, respectively. Entomologists believe the population collapsed due to the egg parasitizing wasp, *Telenomus* sp. In New York, no significant amount of defoliation occurred in 1995.

Fir engraver,
Scolytus ventralis

Region 1: Idaho, Montana	<p>Host(s): Grand fir, subalpine fir</p> <p>Fir engraver beetle-infested stands increased dramatically in northern Idaho in response to abnormally warm and dry weather throughout the summer of 1994. Populations in western Montana, however, remained low. In 1994, only about 7,000 acres of infested area was mapped in northern Idaho. That increased to more than 242,000 acres in 1995. The largest concentrations of engraver beetles are found on the Clearwater and Idaho Panhandle National Forests, although most reporting areas in northern Idaho had significant infestations. Fir engraver populations remained at near endemic levels in western Montana. Only about 350 acres of infested stands were recorded in 1995. Most of those infested acres were on the Lolo National Forest. A reduction in infested area is anticipated as precipitation returns to normal levels.</p>
Region 3: Arizona, New Mexico	<p>Host(s): True firs</p> <p>Tree mortality from fir engraver beetle attacks was detected on 2,685 acres of susceptible host type in 1995 compared to 3,140 acres in 1994. Mortality on federal lands in Arizona occurred on the Apache-Sitgreaves National Forests (280 acres), Coconino National Forest (10 acres), Kaibab National Forest (1,480 acres), and Fort Apache Indian Reservation (80 acres) in Arizona and the Carson National Forest (120 acres), Lincoln National Forest (25 acres) and Navajo Indian Reservation (690 acres) in New Mexico.</p>
Region 4: Idaho, Nevada, Utah, Wyoming	<p>Host(s): Grand fir, red fir, subalpine fir, white fir</p> <p>Fir engraver beetle activity decreased throughout region 4. Regionwide, 170,400 trees were killed in 1995 compared to 180,500 trees in 1994. In Idaho, significant decreases in activity occurred on the Boise and Payette National Forests, and adjacent state and private lands. Only 400 trees were killed in southern Idaho in 1995 compared to 4,400 trees in 1994. Fir engraver beetle activity in Utah decreased with 78,800 trees killed in 1995 compared to 86,600 trees killed in 1994. Most activity was located on the Uinta and Manti-LaSal National Forests, where 34,500 and 18,500 dead trees, respectively, were observed. Elsewhere, mortality was observed on the Dixie, Fishlake, and Wasatch-Cache National Forests. In Nevada, activity decreased from 89,500 trees killed in 1994 to 61,500 killed in 1995. Mortality is located primarily on federal, state, and private lands in the Tahoe Basin area and adjacent areas of the Toiyabe National Forest. Fir engraver beetle activity was not observed on the Bridger-Teton National Forest in western Wyoming.</p>
Region 5: California	<p>Host(s): Red fir, white fir</p> <p>The fir engraver beetle remained the most important forest insect in California in 1995. Substantial tree mortality was found in the Taylor Creek</p>

Late Successional Reserve on the Klamath National Forest, and tree mortality remained high on parts of the Modoc, Lassen and Plumas National Forests. Other areas within these forests had decreasing mortality. The east side of the Tahoe National Forest continued to have stands with high numbers of dead and dying firs.

The Lake Tahoe Basin continued to have mortality above historic norms, but the amount of new mortality can now be considered moderate or less than moderate, which is a marked improvement from recent years. South of Lake Tahoe, mortality remained low in the Sierra Nevada Mountain ecoregion. Southern California had minor amounts of white fir mortality.

Region 6: Oregon, Washington Host(s): True firs

Fir engraver infests true firs in western forests. It attacks pole-sized and mature trees, causing significant mortality during and following periods of drought. Trees infected with annosus root disease are especially subject to attack. Trees defoliated by Douglas-fir tussock moth or western spruce budworm also are likely to be attacked. It commonly breeds in slash and windthrown trees.

Fir engraver activity increased from 1994 reported levels. Regionally, reported levels increased from 358,290 acres (an average of 0.68 tree per acre) in 1994 to 573,600 acres (an average of 0.80 tree per acre) in 1995. Outbreaks continued in areas that have experienced periods of drought, defoliation by Douglas-fir tussock moth or western spruce budworm and in areas infected with root disease. The most significant increase in reported mortality occurred on the Rogue River, Fremont, and Winema National Forests and the Medford District of the Bureau of Land Management. There was also a three-fold increase in reported activity on the Deschutes National Forest.

Forest tent caterpillar, *Malacosoma disstria*

Region 8: Florida, Louisiana Host(s): Oaks, sweetgum, tupelo

An unprecedented outbreak of the forest tent caterpillar caused widespread and severe levels of defoliation in Florida during early March 1995. The outbreak affected both forest and shade trees across portions of six counties (Hardee, Hillsborough, Manatee, Pinellas, Polk, and Sarasota). Live oak and laurel oak were the principle primary hosts; but the unusually high larval populations created numerous instances of secondary feeding and noticeable defoliation of unlikely hosts, such as pine, citrus, and loquat. Hoards of caterpillars in search of food and pupation sites generated much concern and media attention and were a nuisance in urban areas.

The forest tent caterpillar infested tupelo and other bottomland hardwoods in Louisiana in 1995. Trees on about 210,000 acres were totally defoliated; trees on 110,000 acres were more than 50 percent defoliated;

and trees on 65,000 acres had less than 50 percent defoliation, for a total of 385,000 acres infested. It is estimated that the effect of the defoliation will be a 50 percent or greater loss of trees on 320,000 acres of bottomland hardwoods.

Region 9/Northeastern Area:
Maryland, Maine, Minnesota,
New Hampshire, New York,
Ohio, Pennsylvania, Rhode
Island, Vermont

Host(s): Aspen, black cherry, black gum, oaks, red oak, sugar maple, sweetgum, white oak

In Maryland, approximately 16,722 acres of defoliation was caused by the forest tent caterpillar. In Maine, populations appeared to be higher in 1995 than in 1994. In Minnesota, the forest tent caterpillar defoliated approximately 9,410 acres. In New York, surveys revealed over 101,000 acres of defoliation and 18,191 acres of tree mortality. In Pennsylvania, 19 acres of forest tent caterpillar were reported at the Allegheny Portage Railroad, 12 acres at the Johnstown Flood Memorial, 3 acres at Stillwater Lake, and 14 acres at Stape Bend Tunnel. On state and private lands in Pennsylvania, over 370,000 acres were defoliated by the forest tent caterpillar. Two counties in Ohio and all counties in New Hampshire and Rhode Island reported forest tent caterpillars but without measurable defoliation. In Vermont, populations continue to be very low, with no moths caught in pheromone traps but some observed elsewhere.

Jack pine budworm, *Choristoneura pinus*

Region 9/Northeastern Area:
Michigan, Minnesota,
Wisconsin

Host(s): Jack pine, red pine

In Michigan, jack pine budworm defoliated 15,110 acres on the Hiawatha National Forest, 1,195 acres on the Huron National Forest, 4,618 acres on the Manistee National Forest, and 640 acres on state and private lands in the central Upper Peninsula of Michigan. In addition to the defoliation in Michigan, the jack pine budworm caused 10,977 acres of mortality on the Hiawatha National Forest and 3,035 acres of mortality on the Ottawa National Forest. In Minnesota, 66,491 acres were defoliated on state and private lands. In Wisconsin, the jack pine budworm infestation that erupted in 1992 and affected 90 percent of the 400,000 acres of jack pine type is now declining. In northwestern Wisconsin, approximately 17,000 acres were moderately defoliated in 1995 on state and private lands. In addition to the defoliation, the jack pine budworm caused 1,915 acres of mortality on the Chequamegon National Forest and 2,796 acres of mortality on the Nicolet National Forest.

Insects: Native

Jeffrey pine beetle,
Dendroctonus jeffreyi

Region 4: Nevada

Host(s): Jeffrey pine

In areas surveyed, Jeffrey pine beetle activity declined on the Toiyabe National Forest, with 8,800 trees killed in 1995. Significant tree mortality continues to occur in the Tahoe Basin area on federal, state, and private lands. Less widespread activity is present throughout other areas on the Toiyabe National Forest.

Region 5: California

Host(s): Jeffrey pine

Mortality caused by attacks on drought-stressed trees has been increasing for several years throughout the host range in northeastern California. Classes most affected in 1995 were old-growth, overstory trees, and groups of young pole-size pines. Greatest concentrations of mortality were found in the northern half of Lassen Volcanic National Park, the adjacent region of the Lassen National Forest, the east side of the Tahoe National Forest, the vicinity of Lake Tahoe, the Inyo National Forest, and the California portion of the Toiyabe National Forest. In southern California, mortality of Jeffrey pine was low in the San Bernardino Mountains when compared to recent years.

Lodgepole needleminer,
Coleotechnites milleri

Region 5: California

Host(s): Lodgepole pine

Moderate to high degrees of defoliation were observed over 8,000 to 10,000 acres of the Stanislaus National Forest and Yosemite National Park. Some mortality caused by mountain pine beetle was evident within this acreage.

Mountain pine beetle,
Dendroctonus ponderosae

Region 1: Idaho, Montana

Host(s): Lodgepole pine, ponderosa pine, other pines

For the first time in several years, mountain pine beetle populations increased in most host species throughout the region. The 1994 total for all host species was about 23,000 acres infested. That figure increased to nearly 37,000 acres in 1995. About 31,000 of those infested acres are in Montana; the remainder in northern Idaho. Region-wide, an estimated 88,000 trees were killed by mountain pine beetle, three-fourths of them being lodgepole pine. Beetle populations were able to take advantage of the favorable weather conditions of 1994 and increased more rapidly than anticipated in susceptible lodgepole pine stands in northern Idaho and western Montana. Populations remain active and are increasing slightly

on the Lolo and Flathead National Forests in Montana and also show indications of building on parts of the Idaho Panhandle National Forests.

Region 2: Colorado, South
Dakota, Wyoming

Host(s): Limber pine, lodgepole pine, ponderosa pine

Increases in pine mortality indicate that mountain pine beetle populations may be increasing in several locales. The Uncompahgre Plateau on the Grand Mesa–Uncompahgre–Gunnison National Forests has two small on-going outbreaks. Brood production is low in each case and it is uncertain whether populations will continue to grow in 1996. Mountain pine beetles are very active in ponderosa pine on national forest and private residential lands near Buena Vista, Colorado, and will most likely increase in 1996. Mountain pine beetles are also killing significant numbers of high-elevation lodgepole pine in the Twin Lakes area of the San Isabel National Forest. Some mountain pine beetle activity was also noted on the San Juan National Forest, although these populations tended to be associated with other bark beetles and could not be characterized as being in the outbreak phase. Moderate activity and damage was also observed at Buttermilk Ski Area (Aspen Ranger District, White River National Forest). Mortality in ponderosa pine near Laramie Peak, Wyoming, continued in 1995. An aerial survey of the area is planned in 1996. Populations appear to be increasing near Edgerton, Wyoming, in ponderosa pine that was heavily defoliated by pine tussock moth in 1993. From the Colorado-Wyoming border south throughout the Rocky Mountains, mortality appears to be on the rise, with at least nine areas of concern identified in 1995 in ponderosa and lodgepole pine. Aerial survey results of select portions of this area identified 3,996 dead trees on 2,717 acres. Additional survey is planned for 1996. Favorable conditions for mountain pine beetle could lead to a large outbreak in a few years. Tree mortality nearly doubled in the Black Hills of South Dakota from 1994 to 1995. About 6,300 ponderosa pines were killed on about 3,300 acres.

Region 3: Arizona, New
Mexico

Host(s): Ponderosa pine

Tree mortality resulting from mountain pine beetle attacks decreased from 1,990 acres in 1994 to 570 acres in 1995. Trees killed by mountain pine beetle were detected on the Kaibab National Forest (180 acres) in Arizona and the Santa Fe National Forest (330 acres) and the Navajo Indian Reservation (60 acres) in New Mexico.

Region 4: Idaho, Nevada,
Utah, Wyoming

Host(s): Lodgepole pine, ponderosa pine, whitebark pine

Lodgepole and ponderosa pine trees killed by mountain pine beetle attack increased from 24,200 in 1994 to 41,700 trees in 1995. In Utah, 25,500 trees were killed during 1995, whereas 19,100 trees were killed in 1994. Most mortality occurred in ponderosa pine. The largest outbreak is located on the Dixie National Forest, where 15,500 trees were killed. Smaller outbreaks were located on all other national forests in Utah. In Idaho, a significant increase in activity occurred, with 14,400 trees killed in 1995 compared to only 4,800 during 1994. Mortality occurred in both lodgepole

and ponderosa pine. Increases occurred on all national forests in the region. The largest outbreak in southern Idaho continues to be located on the Sawtooth National Recreation Area on the Sawtooth National Forest in lodgepole pine.

Mortality of whitebark pine attributed to mountain pine beetle activity increased four-fold in 1995. Small isolated infestations are located on national forests in Idaho and Utah and on the Bridger-Teton National Forest in western Wyoming. Major outbreaks are located on the Manti-LaSal and Fishlake National Forests in Utah.

Region 5: California

Host(s): Lodgepole pine, ponderosa pine, sugar pine

Sugar pine mortality continued across northern California. The size-class involved varied from place to place, but scattered old-growth pines were frequent targets of attack. Ponderosa pines also were attacked, but smaller-size classes were more often involved than large, overstory pines. Mortality of ponderosa pine increased on the Big Valley District, Modoc National Forest, and mortality of ponderosa and lodgepole pines was particularly prevalent on the Truckee and Sierraville Districts of the Tahoe National Forest. Donner Memorial State Park had the largest contiguous kill of lodgepole pine—more than 100 acres. Pockets of lodgepole pine mortality continued in a variety of areas around Lake Tahoe. Mortality of lodgepole pine was reported on the Pineridge District, Stanislaus National Forest, and in lodgepole pines defoliated by the lodgepole needleminer in the Stanislaus National Forest and Yosemite National Park. Populations of mountain pine beetle were low in the San Bernardino and San Jacinto Mountains of southern California.

Region 6: Oregon, Washington

Host(s): Lodgepole pine, ponderosa pine, sugar pine, western white pine

Mountain pine beetle occurs throughout the range of the pine type in the Pacific Northwest. Both adults and larvae feed in the phloem layer of the inner bark, producing one generation per year. Eventually, girdling of the sapwood and clogging of the conductive tissues by fungi introduced by the beetles can result in mortality. Infestations, in some cases, have resulted in extensive mortality over large areas.

Acres affected by mountain pine beetle increased from 238,000 acres with an average of 2.04 trees per acre in 1994 to 440,000 with an average of 2.07 trees per acre in 1995. Increased activity was detected in all host types except sugar pine. The decrease in detected activity in the sugar pine type is due, in part, to the gradual removal of the host type from the overstory. Greatest increases in activity occurred in the lodgepole pine type on the Deschutes and Okanogan National Forests where the number of acres and trees affected doubled. Other notable increases occurred in the whitebark pine type and in western white pine on the Wenatchee National Forest.

Pandora moth,
Coloradia pandora

Region 6: Oregon

Host(s): Lodgepole pine, ponderosa pine

The pandora moth is a defoliator of pines. Growth loss and possible mortality may follow successive years of outbreak-level defoliation. Trees weakened by successive years of defoliation may also be more susceptible to bark beetle attack. The current pandora moth infestation in central Oregon is in its sixth generation. Defoliation, most of which occurs in even-numbered years, has increased with every generation since the infestation was first observed in 1986.

In 1994, there was ample evidence of a naturally occurring virus throughout the larval population. Despite the effects of the virus, many larvae pupated successfully in the fall of 1994 and produced a sizeable population of moths in the summer of 1995. It appears, however, that relatively few eggs were laid, and larval populations may be lower in 1996 than they have been during the previous three generations.

The effects of the high pandora moth populations have been mostly cosmetic. Several communities in central Oregon have been inundated with the large moths, which are attracted to street lights. The defoliation produced by the larvae have caused concern, but for the most part, trees have generally recovered after the current-year's foliage flush later in the summer.

A special pandora moth survey is scheduled for June of 1996 to assess the status of the outbreak.

Pine engraver,
Ips spp.

Region 1: Idaho, Montana,
Wyoming

Host(s): Lodgepole pine, ponderosa pine

Pine engraver populations also increased dramatically in region 1 from 1994 to 1995. In 1994, only about 2,100 acres were infested. This increased to almost 25,000 acres in 1995. Once again, this increase is attributed to the extremely favorable weather conditions in 1994 that permitted unusually high brood production and survival. The areas of greatest tree mortality were the low-elevation ponderosa pine stands in western Montana and northern Idaho. A return to wet, cool conditions in the spring of 1995, however, resulted in fewer attacks during the 1995 beetle flight season. As such, we believe a notable decrease in infested area will be realized in 1996.

Region 2: Colorado, South
Dakota, Wyoming

Host(s): Lodgepole pine, ponderosa pine

One area of 400 *Ips*-killed ponderosa pine was mapped from the air south of Castle Rock in Colorado, where there is disturbance caused by the con-

struction of new housing. Small pockets of top killing and tree mortality continued to be present in ponderosa pine, especially in the southern Black Hills in South Dakota. Populations built up at Mt. Rushmore National Memorial where thinning activity was on-going; pheromone traps were used to reduce infestations. In Wyoming, *Ips* mortality was light to moderate across the 5,000 acres of ponderosa pine that was heavily defoliated by the pine tussock moth in 1993. Half the dead pines in impact plots had been attacked by *Ips*.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Ips beetle-killed trees were detected on 2,500 acres of the ponderosa pine forest cover type in 1995 compared to 4,135 acres in 1994. Mortality occurred on the Coconino National Forest (170 acres), Coronado National Forest (130 acres), Kaibab National forest (50 acres), Prescott National Forest (120 acres), Tonto National Forest (810 acres), San Carlos Indian Reservation (100 acres), and the Fort Apache Indian Reservation (80 acres) in Arizona and on the Lincoln National Forest (1,040 acres) in New Mexico.

Region 4: Idaho, Nevada, Utah

Host(s): Lodgepole pine, ponderosa pine

Mortality due to pine engraver beetle remained low throughout region 4. Activity is often associated with western pine beetle. In Utah, populations were found in slash of ponderosa and lodgepole pine.

Region 5: California

Host(s): Pines

Pine engravers were associates of other bark beetles or were found in association with slash, storm breakage, blowdown, and trees with root disease and drought stress. Host species reported were Monterey, Bishop, knobcone, ponderosa, Jeffrey and pinyon pines.

Region 6: Oregon, Washington

Host(s): Ponderosa pine

Pine engraver beetles affect all species of pine but are most notable for their effect on ponderosa pine. Populations commonly build up in weakened trees, improperly treated logging and thinning slash, and windthrow. High populations in warm, dry years may kill large numbers of apparently healthy saplings and pole-sized trees as well as tops of mature trees.

Aerially detected pine engraver activity remained relatively unchanged from 1994 levels. Of the 5,700 acres reported in 1995, the majority of activity was detected on private lands in the central Oregon and Umatilla reporting areas. Information from field locations in the Blue Mountains suggests that pine engraver beetle activity is more widespread than reported by aerial survey.

Region 8: Regionwide

Host(s): Southern pines

In 1995, damage from *Ips* beetles was about average. Although areas damaged by Hurricane Opal in Alabama, the Carolinas, and Georgia were affected somewhat, damage to residual stands was minimal.

**Pine sawflies,
Neodiprion spp.**

Region 8: Arkansas, Florida

Host(s): Southern pines

An outbreak of the blackheaded pine sawfly, *Neodiprion excitans*, caused severe levels of defoliation (50 to 100 percent) on over 5,000 acres of loblolly pine forests of virtually all ages in Levy County, Florida. Sawfly problems have plagued loblolly forests in this area for over three years and the situation has caused one manager to implement chemical control tactics using an aerially applied insecticidal treatment.

High populations of the redheaded pine sawfly, *Neodiprion lecontei*, have caused local levels of severe defoliation on longleaf and slash pine forests generally less than ten years old, in four neighboring counties of central Florida (Lake, Polk, Orange and Osceola), as well as in Gilchrist County.

The loblolly pine sawfly, *Neodiprion taedae linearis*, occurred in large numbers in the south-central counties of Arkansas in the spring of 1995. The outbreak caused noticeable defoliation over an extensive area. In some localities defoliation was severe with some trees being completely defoliated.

**Roundheaded pine
beetle,
*Dendroctonus adjunctus***

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine

Roundheaded pine beetle-caused tree mortality was detected on 29,900 acres of host type in 1995 compared to 24,840 acres in 1994. Mortality occurred on the Coronado National Forest (310 acres) in Arizona and on the Lincoln National Forest (12,295 acres) and Mescalero Indian Reservation (17,295 acres) in New Mexico.

**Southern pine beetle,
*Dendroctonus frontalis***

Region 8: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Host(s): Southern pines

Southern pine beetle (SPB) populations rebounded dramatically after declining in 1994. Compared to 1994, the number of SPB infestations in region 8 in 1995 increased by more than 5 times (10,700 spots to 57,800

spots), and the number of affected acres increased by more than 4 times (from 5,250,700 acres to 21,675,900 acres). The number of beetle infestations increased in every state except Texas, Tennessee, and Virginia; 79 percent of the spots are on state and private lands. Southern pine beetle losses will likely exceed the record-setting outbreak of the mid-1980's. Monetary loss estimates were in excess of \$300 million. Populations reached outbreak levels in parts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Arkansas.

On National Forest System lands, the area most seriously impacted was the National Forests in Mississippi. More than 5,000 infestations were detected and over 120 million board feet of beetle-killed timber have been salvaged. Because of the severity of the problem, the Holly Springs and Homochitto National Forests initiated an incident command system, treating this outbreak like a forest fire. National Forest personnel from regions 8 and 9 and the Mississippi Forestry Commission staff were detailed to help suppress the beetle outbreak.

On private land, 22 of South Carolina's 46 counties were in outbreak status and losses exceeding \$107 million to the timber resource are estimated. The situation was so severe that on August 8, 1995, the Governor of South Carolina declared a Forest Disaster. Industry worked closely with state and federal officials to facilitate the control efforts in the outbreak areas. However, the losses equaled slightly more than 10 percent of the forest resources destroyed by Hurricane Hugo.

In other parts of the South, beetle activity increased dramatically as well. In the eastern section of North Carolina, 37 counties were classified as outbreak. In Georgia, beetle activity was high along the Coastal Plain, Piedmont, and mountains, with 17 counties classified as outbreak and over 100 counties with reported activity. In Florida, last year's outbreak in the city of Gainesville continued and populations reached that status in 8 north Florida counties, mainly infesting industrial slash pine plantations. In Alabama, 56 counties were in outbreak status and losses exceed \$40 million. Mississippi had high populations in the northeast corner of the state. Twenty-six counties were classified as outbreak. Louisiana experienced an outbreak in the area north of New Orleans and Baton Rouge and also along the border with Arkansas. Twenty-one parishes (counties) were classified as outbreak. Southern pine beetle activity was high in southern Arkansas, with 13 counties included in the outbreak. The Ouachita National Forest in central Arkansas also had a dramatic increase in losses due to southern pine beetle infestations.

In contrast, southern pine beetle activity remained low in east Texas, the area historically known to experience the most dramatic losses. The Texas Forest Service reported only 55 infestations and no outbreak counties.

Region 9/Northeastern Area:
Delaware, Maryland, West
Virginia

Host(s): Loblolly pine, pitch pine, Virginia pine

Southern pine beetle populations caused mortality on 20 acres in Delaware. In Maryland, little activity was reported through August; however, spots

began to form in late summer after a hot, dry period. A total of 20 small spots (less than 10 trees) were found in Somerset and Worcester Counties.

Spruce beetle,
Dendroctonus rufipennis

Region 1: Idaho, Montana

Host(s): Engelmann spruce

Spruce beetle populations remained low throughout region 1 in 1995, though there was a near five-fold increase in infested area in western Montana. In northern Idaho, only 121 acres were recorded as infested. Most of this occurred as small and scattered groups of trees on the Idaho Panhandle and Nez Perce National Forests. In western Montana, 157 infested acres were recorded in 1994. That increased to 767 acres in 1995. Most population increases were observed on the Flathead and Gallatin National Forests and in Glacier and Yellowstone National Parks. The infestations in Glacier National Park appear to be the ones most likely to continue increasing.

Region 2: Colorado, Wyoming

Host(s): Engelmann spruce

Although significant amounts of windthrow were experienced throughout Colorado in the spring of 1995, only small numbers of spruce beetle were found. The vast majority of the downed spruce had been infested with *Ips pilifrons*.

Region 3: Arizona, New Mexico

Host(s): Spruce

Spruce beetle-caused tree mortality increased from 760 acres in 1994 to 1,240 acres in 1995. Mortality was detected on the Coconino National Forest (10 acres), Kaibab National Forest (110 acres), and the Fort Apache Indian Reservation (15 acres) in Arizona and on the Carson National Forest (175 acres), Cibola National Forest (360 acres), Gila National Forest (30 acres), Lincoln National Forest (215 acres), Santa Fe National Forest (235 acres), and Navajo Indian Reservation (90 acres) in New Mexico.

Region 4: Idaho, Utah, Wyoming

Host(s): Spruce

Mortality from spruce beetle infestation decreased significantly during 1995, with only 28,000 trees killed compared to 45,200 in 1994. This decrease was attributed to a decline in host type on the Payette National Forest due to recent outbreaks and extensive wildfire in infested areas. No significant mortality was reported on any other national forests in southern Idaho. In Utah, where 27,000 trees were killed, activity increased on the Fishlake and Dixie National Forests and decreased on the Manti-LaSal National Forest. No significant mortality was observed on the Bridger-Teton National Forest in western Wyoming.

Insects: Native

Region 5: Northwestern
California

Host(s): Sitka spruce

No activity was reported.

Region 6: Oregon, Washington

Host(s): Engelmann spruce

The spruce beetle infests all species of spruce and is the most significant mortality agent of mature spruce trees. Populations build up in windthrown trees. Stand susceptibility can relate to a variety of factors including geographic location, tree diameter, basal area, and percentage of spruce in the canopy.

Spruce beetle activity was lightly scattered in the host type throughout region 6. Approximately 6,900 trees were killed on 9,500 reported acres. Most of the activity reported occurred on federal lands within the Wallowa-Whitman and Wenatchee reporting areas.

Low levels of spruce beetle activity are due, in part, to the gradual removal of preferred host trees by previous infestations.

Region 10: Alaska

Host(s): Lutz spruce, Sitka spruce, white spruce

Spruce beetle infestation achieved the highest level of activity on record in Alaska. Approximately 892,831 acres of on-going and newly infested areas were detected this year; a 40 percent increase over levels detected last year. The most intense activity continues to be on the Kenai Peninsula, with 556,180 acres detected, and the Copper River area, with 170,767 acres detected. Many of these stands have 60 percent or more mortality. Another area of note is the Anchorage Bowl, with more than 8,000 acres recorded. In southeast Alaska, the Haines area experienced its sixth consecutive year of activity, 8,400 acres were detected on Alaska state lands; and the infestation crosses the border into Canada. The Taku River area infestation increased from 75 acres in 1994 to 3,900 this year. Also, the Stikine River delta, with 2,040 acres affected, is the largest new infestation in southeast Alaska. Many ownerships are being affected, with more than two-thirds of the infestations occurring on state and private lands. Over all ownerships, the number of trees that died in 1995 from this infestation totalled over 27 million. This represents mortality of over 1.2 billion board feet of timber resource, or approximately 4 years' worth of harvest volume from the Tongass National Forest. Not surprising, there are numerous impacts associated with these infestations including: (1) loss of merchantable value of killed trees; (2) long-term ecosystem conversion; (3) impacts to wildlife habitat; (4) impacts to scenic quality; (5) fire hazard; and (6) impacts to watersheds and fisheries.

Spruce budworm,
Choristoneura fumiferana

Region 9/Northeastern Area:
 Michigan, Minnesota, New
 York, Vermont, Wisconsin

Host(s): Balsam fir, Norway spruce, white spruce

In Michigan, spruce budworm (*C. fumiferana*) caused approximately 971 acres of defoliation on the Hiawatha National Forest, 4,722 acres on the Huron National Forest, and 45,504 acres on the Ottawa National Forest. The Chippewa and Superior National Forests in Minnesota reported 3,437 and 348,925 acres of spruce budworm defoliation, respectively. In addition, 135,608 acres were defoliated on state and private lands and 17,000 acres on other federal lands. In New York, the insect caused 371 acres of defoliation and 40 acres of mortality in Chautauqua County; this was the first time mortality caused by spruce budworm was observed in the county. The Chequamegon National Forest in Wisconsin reported approximately 10,021 acres of spruce budworm defoliation, whereas the Nicolet National Forest reported 2,525 acres. In Vermont, moth catches in pheromone traps decreased considerably from 1991–1994 levels.

Region 10: Alaska

Hosts: Lutz spruce, Sitka spruce, white spruce

Many areas of interior Alaska have seen their fifth consecutive year of budworm defoliation by *C. fumiferana* var. *orae*, and *C. biennis*. Research studies have shown that the defoliated trees have been significantly stressed. Some top kill and mortality is occurring in seedlings and saplings. State and private lands (including native corporation) were most affected (176,536 acres) with 102,632 acres of federal land other than National Forest System lands carrying the balance. This year, approximately 279,168 acres along the Tanana and Yukon Rivers were affected. Areas of intense defoliation occurred west of Fairbanks (18,681 acres), Tanana River north to Big Delta (13,344 acres), near Kantishna (21,450 acres), and along the Yukon River from Ruby to Stevens Village (225,693 acres). Since 1993, spruce coneworms (*Dioryctria reniculelloides*) have been observed feeding in conjunction with spruce budworms and may be responsible for some of the defoliation attributed to budworms.

There is increasing concern that endemic engraver beetle populations in budworm-impacted areas may take advantage of the stressed trees and explode to outbreak proportions. Also of concern to biologists is the predicted crash in the red squirrel populations. Red squirrels are highly dependent on spruce cones for winter food. Interior spruce have not had a cone crop for almost five years in heavily defoliated areas.

Insects: Native

**Western balsam bark
beetle,**
Dryocoetes confusus

Region 1: Idaho, Montana

Host(s): Subalpine fir

Although being reported for the first time in 1995, western balsam bark beetle populations have been causing significant amounts of tree mortality in high-elevation subalpine fir stands for several years in region 1. Perhaps only one of a complex of pests responsible for reported mortality, which likely includes root diseases and other secondary bark beetles, western balsam bark beetle is the most conspicuous and most aggressive of that complex. It is also capable of killing its host in the absence of other pests. In 1995, more than 49,000 acres were infested regionwide—almost 8,000 in northern Idaho, the remainder in Montana. An estimated 57,000 subalpine firs were killed. Forests most affected in the region are the Idaho Panhandle, Beaverhead, and Gallatin National Forests.

Region 2: Colorado, Wyoming

Host(s): Subalpine fir

Dryocoetes has become increasingly important as a mortality factor in stands of subalpine fir throughout the Rocky Mountains. Fire exclusion has resulted in conditions that favor subalpine fir and when these stands reach a mature state, they are highly susceptible to mortality caused by a root disease/*Dryocoetes* complex. Although this mortality is widely scattered, significant beetle impacts were observed at many important recreation areas, including Aspen Mountain, Aspen Highlands, Snowmass, and Crested Butte ski areas. Mortality was common throughout the spruce/fir forest cover type from the Wyoming–Colorado border south throughout the Rocky Mountains. Additional factors, especially armillaria root disease, and possibly other biotic and abiotic components, are acting together to produce this mortality. Areas near Centennial, Wyoming, and Kremmling and Leadville, Colorado, have especially concentrated areas of mortality. Aerial survey and field confirmation in portions of Colorado documented 6,313 dead subalpine firs on 1,756 acres. Efforts are underway to determine the causes, extent, impact, and mitigation measures possible to deal with this mortality complex.

**Western blackheaded
budworm,**
Acleris gloverana

Region 10: Alaska

Host(s): Mountain hemlock, Sitka spruce, western hemlock

Blackheaded budworm populations crashed in 1995 among the coastal spruce–hemlock forests of southeast Alaska. This year's population crash was as dramatic as the outbreak in 1991 and 1992. The 1995 budworm defoliation occurred on about 13,000 acres (primarily National Forest System lands), down significantly from 193,000 acres recorded in 1994 and

258,000 acre peak in 1993. Although repeated years of budworm defoliation may cause growth loss, top kill or, in severe cases, death of the host, the major influence is on stand composition and structure. To the extent that defoliation reduces overstory crown density, less shade tolerant understory plants may become established. Such habitats favor small mammals, deer, predaceous and parasitic insects, and some insectivorous birds. Budworm larvae also accelerate the nutrient cycling processes by consuming needles and depositing nutrient-rich fecal material on the forest floor. Recent investigations by the Pacific Northwest Research Station indicate that terrestrial insect larvae may be a larger portion of the diet for some species of salmon fry than were previously understood.

**Western hemlock
looper,**
*Lambdina fiscellaria
lugubrosa*

Region 6: Oregon, Washington Host(s): Douglas-fir, Pacific silver fir, Sitka spruce, Western hemlock

The primary host for hemlock looper is western hemlock, although it will feed on other conifer species and understory shrubs found in association with western hemlock. Heavy repeated defoliation during an outbreak can result in tree mortality. Outbreaks typically will last three years and are kept in check by natural biological controls. After three years of moderate to heavy defoliation, no current-year defoliation caused by the western hemlock looper was detected in region 6.

Western pine beetle,
Dendroctonus brevicornis

Region 1: Idaho, Montana Host(s): Ponderosa pine

The acreage of ponderosa pine stands infested by the western pine beetle also increased in both northern Idaho and Montana in 1995. In northern Idaho, the area of infestation increased from 2,111 acres in 1994 to almost 8,050 acres in 1995. Most of this occurred on the Nez Perce Indian Reservation, the Nez Perce National Forest, and within the Craig Mountains reporting areas. Elsewhere, infestations were in widely scattered groups throughout the ponderosa pine type. The increase that occurred in western Montana was not as significant, going from 985 acres in 1994 to slightly more than 1,400 acres in 1995. Most of this occurred as scattered groups on the Bitterroot and Lolo National Forests and in the nearby Garnet Mountain Range.

Region 3: Arizona, New Mexico Host(s): Ponderosa pine

Western pine beetle-killed trees were detected on 1,910 acres of host type in 1995 compared to 2,170 acres in 1994. Mortality on federal lands in Ari-

Insects: Native

zona included that on the Apache-Sitgreaves National Forests (70 acres), Coconino National Forest (90 acres), Coronado National Forest (10 acres), Kaibab National Forest (35 acres), Tonto National Forest (45 acres), Fort Apache Indian Reservation (90 acres), and the Hualapai Indian Reservation (5 acres) in Arizona and that on the Cibola National Forest (10 acres) and Gila National Forest (1,555 acres) in New Mexico.

Region 4: Idaho

Host(s): Ponderosa pine

Western pine beetle activity increased on the Boise, Payette, and Sawtooth National Forests in southern Idaho. About 8,900 trees were killed in 1995 compared to 6,300 in 1994. Pine engraver beetle activity was frequently associated with western pine beetle infestation.

Region 5: California

Hosts: Coulter pine, ponderosa pine

Large ponderosa pines in northwestern California were attacked during the dry summer and fall of 1994, and these trees began to fade in February 1995. Reported areas were the Sacramento River Canyon from Lakehead to Dunsmuir, the upper Trinity River above Trinity Lake, along the Highway 299 corridor from Buckhorn Summit west to Douglas City, and around the Hayfork Valley.

Some mortality was observed in the extreme southeast of the Six Rivers National Forest and in the Lake Successional Reserve east of Anthony Peak, Mendocino National Forest. Mortality was also scattered in the Southern Cascades ecoregion. However, mortality associated with this beetle increased on the Modoc National Forest, at Dutch Flat and Knox Mountain, Big Valley District, and Timber Mountain, Doublehead District.

In some areas of the northern portion of the Sierra Nevada ecoregion, the western pine beetle increased mortality, particularly on the east side of the Lassen, Plumas, and Tahoe National Forests. However, in the southern portion of this ecoregion, mortality associated with the western pine beetle remained generally low.

Western pine beetle was the primary bark beetle attacking Coulter pine in southern California. Low mortality was reported on 180 acres of the Cleveland National Forest and on 85 acres of the Pala Reservation, San Diego County.

Region 6: Oregon, Washington

Host(s): Ponderosa pine

The western pine beetle is periodically destructive to ponderosa pine in the Pacific Northwest. Normally this beetle breeds in large, old trees; windfalls; trees infected by root disease; and trees weakened by drought, overstocking, or fires. Under epidemic conditions, it will attack and kill trees of all ages that have bark sufficiently thick to protect the insect

during development. Two generations per year of this beetle are typical in the Pacific Northwest.

Western pine beetle activity decreased slightly in large ponderosa pines and decreased substantially in pole sized trees in region 6. About 27,600 trees were reported killed in 1995, compared to 29,600 trees killed in 1994. Mortality in smaller, pole-sized trees decreased from 38,200 trees in 1994 to 18,900 trees killed in 1995.

Notable increases in large tree mortality occurred on the Okanogan and Wenatchee National Forests and on the Colville Indian Reservation. The most notable decrease occurred on the Fremont National Forest. Reported mortality in pole-sized ponderosa pines decreased across region 6; most significant decreases occurred on private lands in the Okanogan, Wenatchee, Glenwood and Northeast Washington reporting areas.

Increased populations of bark beetles are expected in areas associated with the extensive fires that burned over many areas of Oregon and Washington during the summer of 1994. It is expected that the scheduled aerial survey in 1996 will begin observing mortality associated with those fires.

**Western spruce
budworm,
*Choristoneura occidentalis***

Region 1: Idaho, Montana

Host(s): Douglas-fir, Engelmann spruce, true firs

In 1993, budworm populations in region 1 collapsed from an average of about 1.7 million acres of detectable defoliation per year to only about 45,000 acres. This was attributed largely to the unusually heavy precipitation levels, accompanied by cool temperatures that occurred throughout that summer. Despite a return to more normal precipitation and temperatures in 1994 and 1995, the decline in defoliation continued, totaling about 2,000 acres in 1994 and zero in 1995. This is the first time since aerial mapping of budworm defoliation was begun in 1948 that no defoliation was detected. We expect that as long as climatic conditions remain favorable for budworm survival and development, populations will slowly rebound in succeeding years.

Region 2: Colorado, Wyoming

Host(s): Blue spruce, Douglas-fir, Engelmann spruce, true firs

Widespread defoliation of Douglas-fir, true firs, and spruce continued throughout the forests of southern Colorado in 1995. Subalpine fir, Douglas-fir, and true fir mortality is common in areas that have been repeatedly defoliated for almost a decade. Activity appears to be chronic in many areas, particularly on the Rio Grande National Forest. Defoliation has increased sharply on the Uncompahgre Plateau, indicating expanding populations. White fir defoliation at Amphitheater Campground (Ouray Ranger District, Uncompahgre National Forest) is continuing, though at

Insects: Native

lower levels than previously reported. Management activities are being implemented there to improve deteriorating stand conditions.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir, spruce, true firs

Western spruce budworm defoliation increased in Arizona from being undetectable in 1994 to a total of 7,065 acres in 1995. Areas experiencing defoliation included the Apache-Sitgreaves National Forests (6,475 acres) and the Kaibab National Forest (590 acres). In New Mexico, defoliation decreased from 369,170 acres in 1994 to 183,790 acres in 1995. On federal lands, defoliation occurred on the Carson National Forest (101,760 acres), Cibola National Forest (5,000 acres), Gila National Forest (880 acres), Lincoln National Forest (720 acres), Santa Fe National Forest (10,160 acres), Jemez Pueblo Indian Reservation (280 acres), Santa Clara Pueblo Indian Reservation (480 acres), and Taos Pueblo Indian Reservation (5,560 acres), and the Navajo Indian Reservation (7,450 acres). Defoliation on non-industrial state and private lands in northern New Mexico totaled 51,500 acres of susceptible mixed conifer host type.

Region 4: Idaho

Host(s): Douglas-fir, true firs

No visible defoliation from western spruce budworm was observed anywhere in region 4 during 1995.

Region 6: Oregon, Washington

Host(s): Douglas-fir, Engelmann spruce, true firs, western larch

Western spruce budworm is a common defoliator of conifers in the Pacific Northwest. Budworm outbreaks commonly occur in the true fir-Douglas-fir forest type. Larvae prefer new foliage but will also feed on older foliage when new foliage is in short supply. On western larch, larvae not only feed on the needles but also mine the woody portion of the shoots. Trees that are repeatedly defoliated show substantial radial growth reduction and are often predisposed to attack by various bark beetles. Increasingly effective fire prevention and suppression during this century have eliminated many major fires and nearly all surface fires. As a result, forests that have had no other disturbances, such as selective harvesting where only non-host trees are removed, have succeeded steadily toward climax and, consequently, an abundant and expanding source of the budworm's favorite food—shade-tolerant, late-successional species.

Areas of visible defoliation increased from 123,000 acres in 1994, to 190,000 acres in 1995. The greatest increase in acreage affected occurred within the Glenwood and Gifford-Pinchot reporting areas. An intensification of defoliation was also recorded for these two areas. Acres affected on the Mt. Hood National Forest were less than half those reported in 1994, and those acres reported were in the light-effects category.

Insects: Nonnative

A leafhopper, *Sophonia rufofascia*

Region 5: Hawaii

Host(s): Numerous, including native plants

The host count is now 307 plant species within 83 families, 67 species of which are indigenous to Hawaii and, of these, 14 are on the endangered species list or are being processed for listing. The insect remains a suspect in the die-off of Uluhe (staghorn) fern.

Balsam woolly adelgid, *Adelges piceae*

Region 1: Idaho

Host(s): Grand fir, subalpine fir

The balsam woolly adelgid, a native of Europe, can slowly kill trees by infesting the twigs and branches, or quickly by infesting the bole. It also causes gouting in the tree crown and sometimes on the bole.

Balsam woolly adelgid populations continue to expand and intensify at many locations in northern Idaho. Aerial survey data estimate that 11,806 acres were infested in 1995. Areas of greatest damage are on the Nez Perce, Clearwater, and Idaho Panhandle National Forests. Significant mortality continues in the larger subalpine fir, but some regenerating trees of both fir species are being killed. In some areas, mortality of the regeneration is as high as 75 percent.

Region 6: Oregon, Washington

Host(s): True firs

The balsam woolly adelgid has become well established in the Pacific Northwest. Activity was observed on 14,400 acres in Washington in 1995. Although there was a slight decrease in the acres reported in 1995, the total number of trees killed increased from 4,300 in 1994 to approximately 12,200 in 1995. The majority of activity was reported on the Gifford-Pinchot and Mt. Baker-Snoqualmie National Forests and the Olympic and Mt. Rainier National Parks. This activity represents a trend in the decline of subalpine fir through-out region 6.

Region 8: North Carolina,
Tennessee, Virginia

Host(s): Fraser fir

Fraser fir has a limited range and occurs predominantly on the highest mountains of the Southern Appalachians. This forest type occurs in pure stands on the highest peaks or in a mixture with red spruce at lower elevations. Since the introduction of the balsam woolly adelgid, 64,700 acres of Fraser fir have been affected. The insect prefers larger fir trees,

Insects: Nonnative

which has led to the demise of almost all mature host trees within the affected areas. Adelgid populations were high again in 1995.

Region 9/Northeastern Area:
Maine, West Virginia

Host(s): Balsam fir, Fraser fir

In Maine, balsam woolly adelgid damaged foliage and shoots in Hancock and Washington Counties. In West Virginia, two nurseries in Raleigh County found balsam woolly adelgid causing mortality to Fraser firs.

Blue gum psyllid, *Ctenarytaina eucalypti*

Region 5: Central and
Southern California

Host(s): *Eucalyptus pulverulenta*, *E. globulus*

First found in 1991, this psyllid is now widespread and occurs in all coastal California counties except Del Norte. The primary parasitoid wasp *Psyllaephagus pilosus* Noyes (Encyrtidae) appears to be spreading rapidly.

Common European pine shoot beetle, *Tomicus piniperda*

Region 9/Northeastern Area:
Illinois, Indiana, Maryland,
Michigan, New York, Ohio,
Pennsylvania, West Virginia

Host(s): Scotch pine, white pine

In Michigan, over 30 counties are under state and federal quarantine for pine shoot beetle. In Ohio, trapping surveys run by the USDA Animal and Plant Health Inspection Service (APHIS) revealed that 13 counties were newly infested with pine shoot beetle, bringing the total number of affected counties in Ohio to 29. In New York, 12 counties are infested. In Illinois, 4 new counties were found to be infested with pine shoot beetle, bringing the total to 14 counties. In Indiana, pine shoot beetle continues to infest over 29 counties. In April 1995, beetles were found in Maryland and West Virginia bringing the total number of states to 8.

Gypsy moth (Asian), *Lymantria dispar*

Region 6: Washington

Host(s): Apple, oaks, sweetgum, other hardwoods

In 1995, 149 gypsy moths were trapped. Of those so far typed, three have been identified as the Asian strain of the gypsy moth. The remainder were identified as the European strain. Eradication projects are planned for each Asian gypsy moth catch site in 1996.

Region 8: North Carolina

Host(s): Alder, larch, oak, poplar, willow, other hardwoods, and some evergreens

In 1993, adult Asian gypsy moths with their characteristic flying females were accidentally introduced at the Military Ocean Terminal at Sunny Point, North Carolina. Hundreds of male moths (European strain, Asian strain, and hybrids) were captured in pheromone traps after this release. In a cooperative eradication project of the North Carolina Department of Agriculture and USDA APHIS in 1994, some 143,000 acres were treated twice with *Bacillus thuringiensis* (Bt) and Gypchek was applied to sensitive areas. The Asian gypsy moth could cause more serious economic and environmental consequences because of its wider range of host species and ability to disseminate through flying. Results of post-treatment monitoring indicated that the 1994 treatment was largely successful, and re-treatment in 1995 was restricted to approximately 2,000 acres.

Gypsy moth (European),
Lymantria dispar

Region 1: Idaho, Montana,
North Dakota, Wyoming

Host(s): Hardwoods

Cooperative detection monitoring for the gypsy moth by USDA APHIS, and the Departments of Agriculture, Forestry, and Lands of various states continued in 1995. A network of strategically located pheromone-baited traps were placed throughout all states in region 1. In 1995, one gypsy moth was captured in Post Falls, Idaho, and two were captured in Yellowstone National Park, Wyoming; one in Grant Village campground and the other at Lookout Point.

Region 2: Colorado, Kansas,
Nebraska, South Dakota,
Wyoming

Host(s): Hardwoods

A total of 1,842 gypsy moth detection traps were deployed throughout Colorado. In addition, 213 traps were placed at 8 delimitation sites. Altogether, a total of 6 single catches were recorded throughout the state, which indicates that there are no established infestations at this time. During 1994 and 1995, two potentially serious introductions of gypsy moth were discovered in Colorado. However, intensive trapping at both sites revealed no infestations. Weather conditions during early spring, 1995 are thought to have been unfavorable for establishment of the moth. In South Dakota, 8 moths were caught in 619 detection survey traps placed statewide, all on private campgrounds or residences. Moths were found in Brown, Custer, Jackson, Meade, and Pennington Counties. No moths were caught in 150 delimitation traps at 6 sites, 3 of which were located where viable egg masses had been detected on nursery stock imported from Michigan. In Nebraska, only one moth was caught in the sprayed block near Bellevue. Six additional single catches were found near Omaha in Douglas and Burt Counties, all at sites where infested nursery stock had been outplanted. In Wyoming, a total of six gypsy moths were caught, one per trap, in or near the following communities: Laramie, DuBois, Wilson,

Insects: Nonnative

Ten Sleep, Grant Village, and Lookout Point. A delimitation survey is planned for each site in 1996.

Region 4: Utah

Host(s): Various deciduous species

No moths were detected in 1995. The eradication project in Utah is an outstanding example of a successful large-scale project. Trapping will be maintained in 1996 to ensure no recurrence.

Region 5: California

Host(s): Many kinds of trees and ornamentals

Nineteen moths were trapped in eight counties. Egg masses and pupal cases have been found on one property in Santa Cruz County. Numbers trapped are about the same as in 1994, with the exception of an area in Santa Cruz County near Felton (six moths and one property with egg masses), and an area in Nevada County near Grass Valley (five moths). The finds in Nevada County are within a high density delimitation zone established in 1994.

Region 6: Oregon, Washington

Host(s): Apple, oaks, sweetgum, other hardwoods

Although no defoliation has been observed in either state, pheromone traps continue to catch moths. These catches represent either new introductions or populations not completely eradicated by the eradication treatments.

In Washington, six eradication projects totaling 1,216 acres were conducted using both ground and aerial applications of *Bacillus thuringiensis* (*Bt*). The 1995 gypsy moth survey resulted in trap catches of 149 individuals. Of those so far typed, all but three have been identified as the European strain of the gypsy moth. The remaining three have been identified as the Asian strain. Eradication projects at each Asian gypsy moth site and four other sites where European gypsy moths were caught are planned for 1996.

In Oregon, eradication projects were conducted in Jackson and Lane Counties. Two ground applications of *Bt* were used on 6.25 acres in Jackson County, and three aerial applications were made on 80 acres in Lane County. All 20 moths trapped in Oregon have been identified as the European strain. A 10-acre eradication project in southeast Portland (ground application of *Bt*) is planned for 1996.

It is expected that new introductions will continue as long as moth populations persist in the East and people move from infested areas to the Pacific Northwest.

Region 8: Arkansas, Georgia,
North Carolina, South
Carolina, Tennessee, Virginia

Host(s): Apple, oaks, sweetgum, other hardwoods

Defoliation in Virginia occurred on approximately 849,000 acres of host type in 1995, as compared to 452,457 in 1994. Defoliation along the front

and higher ridges accounts for the majority of affected acreage. The fungal pathogen *Entomophaga maimaiga* caused widespread collapse of populations over the generally infested portions of Virginia. Due to the collapse, the state plans to treat fewer than 20,000 acres in 1996—a significant decrease from the 120,000 acres treated in 1995.

In north-central Arkansas, 17,800 acres of private land were treated with two aerial applications of *Bt* to eradicate an isolated infestation of gypsy moth in 1995. This area, in the Ozark mountains, had been previously treated in 1994. Follow-up trapping in the summer indicated that numbers of gypsy moth had been significantly reduced.

Elsewhere, there were isolated infestations in northern Georgia (Fannin County, 1,754 acres), western North Carolina (McDowell County, 600 acres; Watauga Co., 900 acres; Buncombe Co., 1,500 acres; and Ashe, Co., 1,400 acres) eastern Tennessee (Unicoi Co., 1,070 acres, and Granger Co., 38,894 acres) and northwestern South Carolina (Horry Co., 2,200 acres). All of these counties with the acreages listed were treated in 1995. In addition 4,000 acres of European gypsy moth was treated in South Carolina as part of the North Carolina Asian gypsy moth eradication project.

Region 9/Northeastern Area:
Connecticut, Delaware, Illinois,
Indiana, Maine, Maryland,
Massachusetts, Michigan,
Missouri, New Hampshire, New
Jersey, New York, Ohio,
Pennsylvania, Rhode Island,
Vermont, West Virginia,
Wisconsin

Host(s): Aspen, black oak, northern pin oak, red oak, white birch, white oak

Connecticut reported 2,700 acres of gypsy moth defoliation. In Delaware, gypsy moth damaged approximately 65,500 acres. Illinois trapped a total of 2,138 male moths. Indiana trapped over 5,000 male moths in a statewide survey; over 20,000 male moths have been caught in the state since 1972. In 1995, Jasper Co., was a new county in Indiana with at least one male moth caught, making the Indiana total 84 counties. Missouri trapped a total of 26 male moths. Massachusetts reported that gypsy moth damaged over 8,700 acres of northern red oak. Maryland reported that approximately 93,864 acres of white and red oak were defoliated. In Michigan, over 85,000 acres were defoliated by the gypsy moth on state and private lands as well as the Huron and Manistee National Forests. In New Hampshire, gypsy moth defoliation was down again in 1995, causing only 1,700 acres of damage. New Jersey reported a total of 39,580 acres of gypsy moth defoliation. In New York, 200 acres were defoliated in Cattaraugus and Nassau Counties. Ohio reported gypsy moth defoliated over 34,000 acres of red oak, a drastic increase from the 7,000 acres the previous year. In Pennsylvania, over 132,500 acres were defoliated. Rhode Island reported 50 acres were defoliated by the gypsy moth in Providence County. West Virginia's oak forests experienced over 103,000 acres of defoliation. In Vermont, gypsy moth populations remain low, with no noticeable defoliation detected. Wisconsin's trapping program caught over 104,000 males moths.

Insects: Nonnative

Hemlock woolly adelgid,
Adelges tsugae

Region 8: North Carolina,
Virginia

Host(s): Hemlock

The hemlock woolly adelgid was first reported in the United States in 1920 on the West Coast. A second introduction occurred on the East Coast near Richmond, Virginia, in 1950. The insect has successfully colonized eastern hemlock, killing trees within 3 to 5 years. The hemlock woolly adelgid threatens the entire range of eastern hemlock. The Shenandoah National Park has reported an 80 percent decrease in the health of eastern hemlock in just 5 years. Most of the hemlock type in Virginia is generally infested, except for southwestern counties; decline and mortality are extensive. Much of the hemlock resource is located in riparian areas and makes the impact of this insect pest significant and devastating. In 1995, the adelgid was discovered in North Carolina. It now infests hemlock in Stokes and Surry Counties.

Region 9/Northeastern Area:
Connecticut, Delaware,
Maryland, Massachusetts, New
Jersey, New York,
Pennsylvania, Rhode Island,
West Virginia

Host(s): Eastern hemlock

In Connecticut, hemlock woolly adelgid is slowly spreading its way northward since its first occurrence along coastal Connecticut in 1985. To date, hemlock woolly adelgid occurs in 154 of 169 towns in Connecticut. In Delaware, hemlock woolly adelgid is infesting hemlock stands in New Castle County. In Pennsylvania, hemlock stands continue to be infested with hemlock woolly adelgid. West Virginia is in its fourth year of surveying for hemlock woolly adelgid and the pest has been found in seven counties. Massachusetts reported nine new infestations including four in a new county record (Worcester County); total towns infested in Massachusetts equals 34. Maryland found hemlock woolly adelgid in Washington County for the first time, bringing the total number of counties infested to 11. In New York, hemlock woolly adelgid is present but not causing any significant damage to hemlocks. In Rhode Island, hemlock woolly adelgid has become established in Washington, Kent, and Providence Counties.

Larch sawfly,
Pristiphora erichsonii

Region 10: Alaska

Host(s): Eastern larch

Larch sawfly activity in interior Alaska rose dramatically in 1995. More than 116,000 acres of heavy defoliation was observed this year versus 311 in 1994 and 12,000 in 1993. The largest area of defoliation occurred south and east of Fairbanks along the Tanana River (72,900 acres). Another 12,000 acres of larch defoliation was observed near Big Delta northward up the Tanana River. Ownerships affected are split 60:40 between federal lands other than National Forest System lands, and state and private land. Although larch sawfly populations occur wherever there is host material, this is the first recorded outbreak in Alaska. Little or no mortality is occurring; however, there is the concern that three consecutive years of

defoliation may be followed by a build up of larch beetle (*Dendroctonus simplex*). Also, heavy defoliation is not aesthetically pleasing in areas of heavy recreational use. Larch sawfly is probably an introduced insect; it was first recorded in North America in Boston, Massachusetts, in 1880.

Disease Conditions by Region

Diseases: Native

Annosus root disease, *Heterobasidion annosum*

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir, ponderosa pine, subalpine fir, western hemlock

Annosus root disease is common in ponderosa pine stands on the Flat-head Indian Reservation and in other western Montana locations. It is widespread on Douglas-fir and true firs on the Clearwater, Nez Perce, and Idaho Panhandle National Forests in Idaho.

Region 2: Colorado

Host(s): Ponderosa pine, white fir

Annosus root disease has scattered distribution in white fir in the mixed conifer cover type throughout southern Colorado. The disease is present and was responsible for a tree failure in the Amphitheater Campground, Ouray Ranger District, Uncompahgre National Forest. The disease was reported as a factor affecting management of mixed conifer stands on the Southern Ute Reservation and in white fir in the Amphitheater Campground. The disease was also noted in the spruce-fir stands at the North Cone and Truby Complex Timber Sale Areas on the Uncompahgre and San Juan National Forests.

Region 3: Arizona, New Mexico

Host(s): Ponderosa pine, true firs

Root diseases and their associated pests are responsible for about a third of the conifer mortality regionwide. *Heterobasidium annosum* accounts for about 20 percent of this mortality. During surveys conducted on the North Kaibab Ranger District, *H. annosum* was found in approximately one percent of the standing live trees.

Region 4: Idaho, Nevada, Utah, Wyoming, California

Host(s): Bitterbrush, chokecherry, Douglas-fir, Jeffrey pine, lodgepole pine, ponderosa pine, spruce, true fir

Infection causes varying amounts of root and butt rot in mature individuals of many tree species and may result in predisposition to windthrow and/or beetle attack. In grand fir and subalpine fir, it is commonly found as a butt rot. Infection-induced mortality occurs occasionally in young ponderosa pine and seldom in other hosts.

Region 5: California

Host(s): Conifers, some hardwoods

Heterobasidion annosum is the most widespread and damaging root disease agent in California. Annosus root disease centers were common in bald eagle roosting areas in portions of northeastern California; mortality of pines was reducing numbers of suitable roosting trees. The disease continued to be reported in white fir and mixed conifer stands in the Sierra Nevada and is of increasing concern as the value of true fir increases. Mortality results when infected trees are subsequently infested with fir engraver beetles.

Region 6: Oregon, Washington

Host(s): Ponderosa pine, true firs, western hemlock

Annosus root disease causes losses in many partially cut white and grand fir stands in southern and eastern Oregon and eastern Washington. Mortality was high where annosus root disease and fir engraver beetles operate as a complex. The new region 6 vegetation inventory now requires examination of cut stumps; this has led to increased reporting and awareness of annosus root disease on many national forests. In eastern portions of the region where many stands were cut 10 to 20 years ago, trees surrounding cut stumps are dying and the severity of the disease is expected to increase with time. Annosus root disease was observed with increasing frequency in stands that are predominantly ponderosa pine on drier sites in eastern Washington and Oregon. Reports of the disease in mountain hemlock and Pacific silver fir in high-elevation stands in the Cascade Range are also increasing. Annosus root disease in low-elevation western hemlock stands primarily causes butt rot; impacts are considered low unless stands are managed at rotations greater than 120 years.

Region 8: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

Host(s): Southern pines (loblolly, slash, shortleaf, longleaf), eastern white pine

Annosus root disease continued to cause significant losses of its pine host in region 8. Mortality and growth losses range from 2 to 25 percent of growing stock volume of managed high-risk stands across the South. The disease is most often associated with thinned pine plantations on sandy, well-drained sites but can be found on a variety of sites, soils, and forest conditions. Bark beetle infestations frequently occur within infected stands.

Armillaria root disease,
Armillaria spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, other conifers

Armillaria root disease is widely distributed in northern Idaho and western Montana. The apparent increase of this root disease in parts of region 1 is attributed, in part, to the increase in Douglas-fir and true firs resulting from fire control and selective harvesting of high-value pine and western

Diseases: Native

larch early in the 20th century. It is also a major cause of mortality in young ponderosa pine plantations (15 to 25 years old).

Region 2: Colorado, South Dakota, Wyoming

Host(s): Engelmann spruce, hardwoods, lodgepole pine, ponderosa pine, subalpine fir, white fir

Armillaria root disease is easily the most common and damaging of the root diseases in region 2. In 1995, the disease was identified as a factor affecting management in various locations in all of the national forests in the Gunnison Zone (southwestern Colorado). Armillaria root disease, together with the western balsam bark beetle (*Dryocoetes confusus*), is a major problem in the spruce-fir cover type of Aspen Mountain and Crested Butte ski areas, and is active (though not as damaging) at Aspen Highlands and Snowmass ski areas. In South Dakota, this root disease continues to kill spruce and ponderosa pine on the Black Hills National Forest. Survey work continues on the Black Hills National Forest to discover the distribution and severity of armillaria root disease. One hundred and four vegetative isolates of armillaria from widely scattered infected trees, including 10 host species in 11 national forests throughout Colorado, South Dakota, and Wyoming have been identified as the biological species *Armillaria ostoyae*. Work is continuing on the identification of collections made in 1995.

Region 3: Arizona, New Mexico

Host(s): Aspen, Douglas-fir, ponderosa pine, spruce, true firs

Armillaria spp. account for about 80 percent of root disease mortality across region 3. A greater percentage of the mixed conifer and spruce-fir forests are infected compared to ponderosa pine type. This region is working to determine the occurrence and effects of armillaria and other root diseases in southwestern forests. During surveys conducted on the North Kaibab Ranger District, armillaria was found in approximately 30 percent of the standing live trees.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Douglas-fir, grand fir, pines, spruce, subalpine fir

Evidence of armillaria root disease can be found throughout region 4. In southern Idaho, northern Utah, Nevada, and Wyoming, it functioned primarily as a weak pathogen or saprophyte causing little direct mortality. In southern Utah, it may act as a primary pathogen, killing mature and immature ponderosa pine and mature fir and spruce.

Region 5: California

Host(s): Conifers, some hardwoods

Armillaria sp., in combination with flatheaded borers or Douglas-fir engraver beetles, killed Douglas-fir in several central coastal locations. The pathogen killed 10-year-old planted giant sequoia saplings in a central Sierra Nevada plantation and also one 49-inch-dbh overstory giant sequoia

Region 6: Oregon, Washington Host(s): Conifers

The most serious losses from this disease occurred east of the Cascade Range in mixed conifer stands. In some stands in eastern Oregon where soils are compacted or displaced, mortality was high and is expected to continue. In other, largely unentered stands, disease activity is equally severe, indicating an especially virulent strain(s) of the fungus. True firs and Douglas-fir sustain the most losses; however, in localized areas ponderosa pine mortality was significant. In mid to high elevation stands in the Cascades of southwestern Oregon, *Armillaria* root disease causes mortality of several conifer species. Mortality on lower slopes west of the Cascades and in the Coast Range was usually confined to younger, stressed trees. Assessing species resistance on a site by site basis and discriminating for the more resistant species during stand management activities is considered the most effective means of controlling spread and mortality.

**Black stain root disease,
*Leptographium wagneri***

Region 1: Idaho, Montana

Host(s): Douglas-fir, lodgepole pine, ponderosa pine

Black stain root disease is less common than other root pathogens, and its importance in region 1 is largely unknown.

Region 2: Colorado

Host(s): Pinyon pine

Continues as a problem on pinyon pine in the southwestern corner of Colorado. Recent widespread mortality was detected on Bureau of Land Management lands south of Redvale. The disease is also of major concern in recreation areas near McPhee Reservoir and at Mesa Verde National Park. Increasing mortality of pinyon pine was reported in the areas to the east and southeast of the Uncompahgre Plateau. Many of the dead trees in this area were infested with *Ips confusus* (pinyon Ips), but the primary factor responsible for this mortality is likely black stain root disease.

Region 3: New Mexico

Host(s): Douglas-fir, pinyon pine

Both *Leptographium wagneri* var. *wagneri*, which infects pinyon, and *L. wagneri* var. *pseudotsugae*, which infects Douglas-fir, are rare in region 3. The former is confined to two isolated areas in northern New Mexico and the latter has been observed only in sites in south-central New Mexico.

Region 4: Idaho, Nevada,
Utah

Host(s): Pinyon pine

This fungus causes mortality of pinyon pine on the Bureau of Land Management Burley District in Idaho, on the Humboldt and Toiyabe National Forests in Nevada, and on the Dixie and Manti-LaSal National Forests in Utah.

Diseases: Native

Region 5: California

Host(s): Douglas-fir, Jeffrey pine, pinyon pine, ponderosa pine

Black stain root disease is common in Douglas-fir plantations and on mature Douglas-fir trees in northwestern California, and is associated with ponderosa and Jeffrey pine mortality over thousands of acres of overstocked eastside pine stands in northeastern California. The disease was associated with yellowing crowns, needle drop, stress cone crops and mortality of pole and small saw timber-sized Douglas-fir in several mixed conifer stands in the central Sierra Nevada.

Region 6: Oregon, Washington

Host(s): Douglas-fir, ponderosa pine

In southwestern Oregon, black stain root disease was the most commonly encountered disease in Douglas-fir plantations. High-risk areas are considered to be those where disturbances such as road building or soil compaction has occurred or where road maintenance equipment injured roadside Douglas-firs. Infected larger individuals were found scattered in previously entered forest stands. Black stain root disease continues to be observed on ponderosa pine east of the Cascades. Best management practices need to be determined to reduce disease incidence and severity.

Dwarf mistletoes, *Arceuthobium* spp.

Region 1: Idaho, Montana

Host(s): Douglas-fir, lodgepole pine, ponderosa pine, western larch

Lodgepole pine dwarf mistletoe (*A. americanum*) infects approximately 2 million acres (28 percent) of the lodgepole pine type in region 1 and causes about 18 million cubic feet of growth reduction annually. Dwarf mistletoe is locally heavy in ponderosa pine stands around Lake Coeur d'Alene and along the Spokane River drainage in northern Idaho. Douglas-fir dwarf mistletoe (*A. douglasii*) infects about .6 million acres (13 percent) of Douglas-fir, reducing growth by approximately 13 million cubic feet annually. Larch dwarf mistletoe (*A. laricis*) occurs on about .8 million acres (38 percent) of western larch stands and reduces annual growth by over 15 million cubic feet.

Region 2: Colorado, Wyoming

Host(s): Lodgepole pine

In region 2, dwarf mistletoes cause the greatest losses from disease, equal at least 10 million cubic feet annually. Forest Health Management funded presuppression surveys on 14,711 acres on 5 national forests and silvicultural control on 1,284 acres on 5 national forests. In addition, 4,500 acres of Department of the Interior lands were surveyed and 325 acres were treated. Continuing emphasis is being placed on suppression projects in developed recreation sites. In Colorado, 50 percent of the lodgepole pine type is infected with *A. americanum*. It is widespread in some areas of the Bighorn National Forest, though not yet a management concern.

Losses of ponderosa pine due to southwestern dwarf mistletoe (*A. vaginatum* subsp. *cryptodum*) amount to 885,000 cubic feet annually. In 1995, Forest Health Management provided funds for silvicultural control on 109 acres on the Southern Ute Reservation and 51 acres on the Salida Ranger District, San Isabel National Forest. Suppression projects emphasized tree removal and pruning of infected trees in developed recreation sites.

Douglas-fir dwarf mistletoe (*A. douglasii*) occurs mostly in the southern two-thirds of the state. Forest Health Management provided funds for silvicultural control on 26 acres on the Salida Ranger District, San Isabel National Forest. It was also identified as a management concern at Mt. Princeton Campground (Salida Ranger District), and in the North Park Salvage Wildlife Units, Saguache Ranger District, Rio Grande National Forest.

Pinyon pine dwarf mistletoe (*A. divaricatum*) continued as a minor problem in western Colorado. However, perceived impacts of the disease are becoming more evident as people move into the pinyon-juniper woodlands of southern Colorado.

Region 3: Arizona, New Mexico

Host(s): Douglas-fir, pines, spruce, true firs

Dwarf mistletoes are the most significant disease-causing organisms in region 3. Over one million acres of National Forest System commercial timberlands in each state have some level of dwarf mistletoe infection. Several hundred thousand additional infected acres occur in noncommercial and reserved areas, woodlands, and other public and private forest lands. There is some evidence that the incidence of dwarf mistletoe on ponderosa pine has increased in recent decades. This increase is likely a result of fire suppression (fire being the primary natural control agent) and selective cutting.

Region 4: Idaho, Nevada, Utah, Wyoming

Host(s): Bristlecone pine, Douglas-fir, Jeffrey pine, limber pine, lodgepole pine, true firs, western larch, whitbark pine

Suppression projects continue to remove infected overstory trees; however this forest disease remains the most widespread and frequently observed disease within region 4. Regional incidence by major host species is as follows: lodgepole pine = 60 percent infected, ponderosa pine = 44 percent infected, and Douglas-fir = 43 percent infected.

Region 5: California

Host(s): Douglas-fir, pines, true fir

Dwarf mistletoes are infecting conifers on about 4.2 million acres of National Forest System lands, with approximately 25 percent of the acres in California infested. These numbers have not changed significantly over the last 20 to 30 years. Dwarf mistletoes' distribution and impacts change slowly from year to year. Infections are slowing tree growth, contributing to tree mortality and altering forest successional patterns. Western dwarf mistletoe (*A. campylopodum*) continues to heavily infect Jeffrey pine in

Diseases: Native

recreation areas throughout southern California. Red fir dwarf mistletoe (*A. abietinum*), in conjunction with *Cytospora* canker, caused tree decline and mortality in red fir stands in the Klamath Mountains.

Region 6: Oregon and Washington

Host(s): Conifers

Dwarf mistletoes are present on approximately 9.5 million acres of forested lands in region 6. Their status changes little from year to year. However, long-term impacts, including reduced growth, mortality, deformity, and top kill, are significant, particularly in unmanaged stands. All conifer species are affected to some degree. Douglas-fir dwarf mistletoe is abundant east of the Cascades and in southwestern Oregon. Larch dwarf mistletoe causes significant effects in northeastern Oregon and central to eastern Washington.

Region 10: Alaska

Host: Western hemlock

Hemlock dwarf mistletoe (*A. tsugense*) is the most important disease of western hemlock in unmanaged, old-growth stands throughout southeast Alaska as far north as Haines. The incidence of dwarf mistletoe varies from stands in which almost every western hemlock tree is severely infected to other stands in which the parasite is absent. Heavily infected trees have branch proliferations (witches brooms), bole deformities, reduced height and radial growth, less desirable wood characteristics, top-kill, and severely infected trees may die. These are all potential problems in stands managed for wood production; however, the disease also creates a greater diversity of forest structure and contributes unique wildlife habitat.

Fusiform rust,
Cronartium quercuum
f. sp. *fusiforme*

Region 8: Florida, Georgia,
North Carolina, South
Carolina, Virginia

Host(s): Southern pines

Fusiform rust is the most damaging disease of loblolly and slash pines in the South. Cankers on the main stem of young pines result in death or deformity by girdling the stem; branch cankers may spread into the stem of young pines resulting in death or deformity by girdling the stem; branch cankers may spread into the main stem causing cankers on older trees that result in decay, degrade, or stem breakage. According to analysis of the most recent forest inventory data, an estimated 8.2 million acres of loblolly and slash pine in these 5 states have infection levels of 10 percent or greater, 32 percent of the host acreage. Georgia has the worst disease situation, with 4.6 million acres with 10 percent or more infection; 49 percent of host type. South Carolina is second with 1.4 million acres (or 31 percent) of host type with 10 percent or more infection. Annual economic losses due to fusiform rust are estimated to be over 47 million dollars.

Heart rot, many *Basidiomycetes*

Region 10: Alaska

Host: All tree species

Heart rot causes more economic loss than all other diseases in Alaska. Roughly 30 percent of the old-growth timber volume in southeast Alaska is defective because of heart rot fungi. In interior and south-central Alaska hardwoods, substantial volume loss can be expected in stands 80 years old or older. Sap rot decay routinely and quickly develops in spruce trees attacked by spruce bark beetles. Large amounts of potentially recoverable timber volume are currently being lost annually on the Kenai Peninsula, where salvage logging has not kept pace with tree mortality from the continuing spruce beetle epidemic.

Besides economic effects, heart rot fungi appear to be the primary disturbance agents that drive the canopy-gap process of disturbance in many old forests. They are vital agents that alter forest structure and succession, and directly enhance wildlife habitat. Specific heart rot levels can be achieved in managed forests by controlling the frequency and size of bole wounds during stand entries. Studies on the ecological roles of heart rot and the rate of wood decay in wounded trees continue.

Laminated root disease, *Phellinus weirii*

Region 1: Idaho, Montana

Host(s): Douglas-fir, grand fir

Laminated root disease is very severe on parts of the Lolo, and Kootenai National Forests in Montana, as well as the Idaho Panhandle National Forests. Damage from laminated root disease has increased in recent years. This is attributed, in part, to the loss of root disease-tolerant western white pine to blister rust; an increase in Douglas-fir and true firs as a result of fire control; and selective harvesting of high-value, root disease-tolerant pine and western larch early in the 20th century.

Region 5: Northern California

Host(s): Douglas-fir, white fir, other conifers

Laminated root rot, a relatively minor disease in California, is being reported with increasing frequency in portions of the Klamath Mountains. Multiple coalescing disease centers in white fir and Douglas-fir were reported, covering an area about 100 acres in size. Management activities to address the disease are planned.

Region 6: Oregon, Washington

Host(s): Conifers

Laminated root rot was the most serious forest tree disease west of the Cascade Mountains in Washington and Oregon. Overall, an estimated 8 percent of the area in susceptible species is affected in this portion of region 6. Locally, the area affected may be as much as 15 to 20 percent of the area in susceptible species. East of the Cascades, laminated

Diseases: Native

root affects mixed conifer stands north of the Crooked River in central and northeastern Oregon and throughout eastern Washington. Effects of the disease include significant changes in species composition, size, and structure. Regeneration of susceptible species in root disease centers may not grow beyond sapling and pole-size. Hardwood trees and shrubs, which are immune to the fungus, often increase their site occupancy.

Oak wilt, *Ceratocystis fagacearum*

Region 2: Kansas, Nebraska

Host(s): Oak species

In Kansas, oak wilt continues to be a problem in isolated areas, but fewer incidents of activity were reported.

Region 8: Arkansas, Kentucky,
North Carolina, South
Carolina, Tennessee, Texas,
Virginia

Host(s): Oaks, mainly red oak group; live oaks in Texas

Oak wilt continued to be epidemic in central Texas. New detections increased the number of affected counties to 61. A cooperative oak wilt suppression project continued in central Texas. In other states, little new or serious disease activity was reported.

Region 9/Northeastern Area:
Indiana, Iowa, Minnesota,
Ohio

Host(s): Black oak, red oak, white oak

Brown, Newton, and Starke Counties in Indiana reported some mortality in the red oak forest type. In Iowa, oak wilt surveys revealed about 4,050 acres of dieback and decline in the oak-hickory forests and revealed that about 550 trees were damaged in the urban/ornamental forest type. In Minnesota, 9,956 acres of mortality were reported on red and white oaks. In addition, oak wilt infection centers were treated with assistance from the Federal Cooperative Suppression Program. In Ohio, Lucas County reported 52 acres of mortality on red oaks.

Sugar maple anthracnose, *Gloeosporium apocryptum*

Region 9/Northeastern Area:
Pennsylvania

Host(s): Sugar maple

In Pennsylvania, 173,330 acres of sugar maple were killed due to anthracnose in 11 counties.

Diseases: Nonnative

Beech bark disease, *Nectria coccinea* var. *faginata*

Region 8: North Carolina,
Tennessee

Host(s): American beech

Mortality from this disease was first reported in the Great Smoky Mountains National Park, the southernmost extension of the disease. The area affected was approximately 100 acres in a 3-county area (Swain, NC; Haywood, NC; and Sevier, TN). There has been a large increase in beech bark scale distribution and disease centers within the Great Smoky Mountains National Park during 1995.

Region 9/Northeastern Area:
Connecticut, Maine,
Massachusetts, New
Hampshire, New Jersey, New
York, Ohio, Pennsylvania,
Rhode Island, Vermont, West
Virginia

Host(s): American beech

In Massachusetts, Geographic Information System (GIS) acreages, when calculated, showed 4,764 acres of dieback and decline and 431 acres of mortality in Berkshire County. In New York, Chautauqua County reported heavy beech scale and mortality on 50 acres. In Vermont, beech bark disease continued to cause areas of chlorosis, dieback, mortality, and stem defect on 9,249 acres. Populations of beech scale increased in monitoring plots, probably due to the mild winter and low rainfall in the growing season. In West Virginia, millions of trees were killed in a 652,000-acre area in Pendleton, Pocahontas, Randolph, Tucker, and Upshur Counties.

Dutch elm disease, *Ophiostoma (=Ceratocystis)* *ulmi*

Region 1: Idaho, Montana,
North Dakota

Host(s): American elm

Dutch elm disease continued to spread in urban areas in North Dakota and Montana. Montana's highest losses are occurring in the cities of Billings and Great Falls. In North Dakota, heavy losses have occurred at the Knife River Indian Villages National Historic Site. In northern Idaho, it has been reported in Moscow, where despite an aggressive treatment program begun several years ago, seven more elms were lost to the disease in 1995.

Region 2: Colorado, Kansas,
Nebraska

Host(s): Elm species

In Colorado, Dutch elm disease reports increased dramatically over past years. Hundreds of trees were removed in the Denver metropolitan area in 1995. In Kansas, the disease is a serious problem in many urban areas,

Diseases: Nonnative

but reports were about normal in 1995. In Nebraska, incidence of the disease was greater in 1995 than in recent years.

Region 8: Regionwide

Host(s): Elms—particularly American elm

Dutch elm disease fungus, *Ophiostoma ulmi* (= *Ceratocystis ulmi*), continues to cause scattered to localized mortality at generally low levels in urban and wild populations of elms.

Region 9/Northeastern Area:
Areawide

Host(s): American elm, Siberian elm, slippery elm

In Indiana, a recent “wave” of mortality from Dutch elm disease may be the result of a new strain of the fungus, *Ophiostoma ulmi*, *O. novo-ulmi* (= *Ceratocystis ulmi*), and an increase in bark beetle populations and in the numbers and size of elms supporting the disease. In Iowa, an increase of Dutch elm disease caused over 1,240 acres of mortality in 73 counties. An Ohio survey revealed Dutch elm disease on 2 trees in Ross County. Dutch elm disease remains common to American elm throughout Vermont.

White pine blister rust,
Cronartium ribicola

Region 1: Idaho, Montana

Host(s): Western white pine, whitebark pine

White pine blister rust causes extensive tree mortality throughout the range of western white pine. The death of naturally occurring regeneration has virtually eliminated western white pine from many forests, resulting in a major transition in forest types. Restoration efforts are concentrating on planting genetically improved, rust-resistant stock. In addition, pruning cankers from branches of natural regeneration is being done to improve survival in some areas. Blister rust is also causing extensive mortality in high-elevation five-needle pines. Recent surveys have found infection rates in whitebark pine regeneration of up to 90 percent. There is a growing concern that severe losses of whitebark pine may have significant impacts on water and wildlife in these fragile ecosystems.

Region 2: South Dakota,
Wyoming

Host(s): Limber pine

The disease is present in a remote stand in the Black Hills of South Dakota. Branch mortality continued at several locations in the Bighorn, Medicine Bow, and Shoshone National Forests. Branch mortality is common and a management concern in the Vedauwoo Campground on the Medicine Bow National Forest, Wyoming, as is the heavy branch and tree mortality in the Sunlight area of the Shoshone National Forest, Wyoming.

Region 3: New Mexico

Host(s): Southwestern white pine

White pine blister rust occurs throughout most of the range of southwestern white pine (*Pinus strobiformis*) in the Sacramento Mountains, White Mountains, and Capitan Mountains of southern New Mexico. Roughly one-half million acres are affected. This disease has not been found in Arizona.

Region 4: Idaho

Host(s): Whitebark pine, limber pine

A formal survey of five-needled pines was initiated in 1995 to quantify the incidence and intensity of disease and to determine site and stand characteristics of infected areas.

Region 5: California

Host(s): Sugar pine, Western white pine, whitebark pine

Branch flagging caused by white pine blister rust was common and very striking on sugar pines growing on ridge tops, mid-slopes, and stream bottoms on central Sierra Nevada forests. New reports of the disease on high-elevation white pines continued. Indications were that 1995 would be a blister rust wave year over much of the Sierra Nevada range. Leaves of *Ribes* were covered with blister rust, and telia were developing well. The region 5 Genetic Resource Program has identified some sugar pine families with slow rusting resistance and has made selections of seed from western white, foxtail, and white bark pines available to begin research on resistance in these species.

Region 6: Oregon, Washington

Host(s): Sugar pine, Western white pine, whitebark pine

Cronartium ribicola was introduced to the West Coast in 1910. Its impacts include top-kill, branch flagging, and tree mortality. Although much of the mortality associated with this disease occurred earlier in the century, its impacts are still great in wild populations of five-needled pines throughout their ranges. Locally, this disease, in combination with mountain pine beetle, threatens the health of the species. Of particular concern are the effects of blister rust in whitebark pine at high elevations in the Cascades and the Blue and Wallowa Mountains.

Diseases: Origin unknown

Butternut canker, *Sirococcus clavigignenti-juglandacearum*

Region 8: Alabama, Arkansas, Kentucky, Mississippi, North Carolina, Tennessee, Virginia

Host(s): Butternut (white walnut)

This disease has been in the South for at least 40 years and is estimated to have killed 77 percent of the trees in North Carolina and Virginia. The fungus kills native trees, saplings, and regeneration. The USDA Forest Service has placed a moratorium on the harvesting of healthy butternut trees. Trees exhibiting resistance have been found in North Carolina, Kentucky, and Arkansas. A cove with a large number of canker-free and cankered trees has been located in western North Carolina. All potentially resistant trees are being propagated by grafting and nut collection for host resistance studies. Butternut canker is projected to spread and kill most of the resource, including regeneration. The species will be replaced by other species on these sites (for example, black walnut). It is too early to project the benefits of selection and breeding.

Symptomatic trees have been located in nine counties in Arkansas, Alabama, and Mississippi. Isolations of the causal fungus have, to date, been positive from two counties in Arkansas.

Region 9/Northeastern Area:
Areawide

Host(s): Butternut

In Connecticut, butternut canker is present in all counties. In New Hampshire, butternut canker has been found causing mortality in every county of the state. Over 425 trees in 10 counties were experiencing dieback and decline caused by butternut canker. In New York, Schoharie County reported finding butternut canker on about 5 acres. In Vermont, butternut canker continues to cause widespread mortality throughout the state.

Dogwood anthracnose, *Discula destructiva*

Region 8: Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee, Virginia

Host(s): Flowering dogwood

Dogwood anthracnose was first noted in the South in 1987 with the report of 30,000 acres affected in the Cohutta Wilderness in northern Georgia. Surveys and impact plots across the seven affected southern states have now identified 229 counties impacted by this disease. Dogwood anthracnose is primarily found in the mountains, foothills, and upper Piedmont. Damage is most severe in the forest environment at higher elevations and in cool moist areas in the lower elevations.

Region 9/Northeastern Area:
Connecticut, Indiana, Maine,
Maryland, Massachusetts,
Missouri, New Hampshire, New
Jersey, New York, Ohio,
Pennsylvania, Rhode Island,
Vermont, West Virginia

Host(s): Flowering dogwood

In Maryland, surveys of dogwoods found the disease present in all counties. In Missouri, dogwood anthracnose was found on seedlings in two nurseries in Crawford and Montgomery Counties. In New York, during a survey for gypsy moth egg masses in a park, dogwood anthracnose was found in Queens County. In Ohio, dogwood anthracnose was laboratory verified in Ashland, Athens, Franklin, Hamilton, Knox, Scioto, Stark, and Vinton Counties. Also in Ohio, dogwood anthracnose caused 260 acres of mortality in Athens and Hocking Counties.

Pitch canker,
Fusarium subglutinans

Region 5: Coastal California

Host(s): Bishop pine, Monterey pine, Monterey pine X knobcone pine, Douglas-fir

Pine pitch canker continues to spread to new areas and is now reported from 14 coastal and adjacent inland counties, from San Diego to Mendocino. With the report of the disease at Cambria, the pathogen is now present in all three of California's native Monterey pine stands. A Pine Pitch Canker Task Force, a coalition of governmental, private, and non-profit groups was formed. The task force has disseminated information on the disease, identified management and research priorities, and coordinated disease management activities.

**Port-Orford-cedar
root disease,**
Phytophthora lateralis

Region 5: California

Host(s): Port-Orford-cedar, Pacific yew

About 9,000 acres of the 160,000 acres of National Forest System lands in California that have Port-Orford-cedar are infested. *Phytophthora lateralis* was reported for the first time in native stands of California outside of the Smith River watershed. The pathogen has been identified in one area at the headwaters of a creek that is part of the Klamath River watershed. Several additional creeks within the Smith River watershed are now infested.

Region 6: Oregon

Host(s): Port-Orford-cedar

Port-Orford-cedar root disease causes mortality of Port-Orford-cedar in southwestern Oregon. Where it has been introduced, the disease causes extensive mortality on sites favorable for infection and spread of its water-borne spores, especially along creeks, in low-lying areas, and below roads where water is channeled.

Diseases: Origin unknown

Evidence of the disease was reported over a total of 21,000 acres. Within these areas, mortality was distributed as scattered pockets or individual trees.

Other Conditions by Region

Declines and Complexes

Ash yellows/declines

Region 9/Northeastern Area:
Iowa, New York, Ohio,
Vermont

Host(s): Green ash, white ash

In Iowa, approximately 500 acres showed signs of dieback and decline of green and white ash. In New York, 50 acres of white ash showed symptoms of dieback and decline in Chautauqua County. Ohio reported ash decline in Montgomery, Ross, Warren, and Wayne Counties on about 30 acres. Ash yellows remains an important cause of dieback and mortality in Lamoille County, Vermont.

Aspen defoliator complex

Region 3: Arizona, New
Mexico

Host(s): Aspen

Aspen defoliation caused by this complex of insects and diseases (including large aspen tortrix, *Choristoneura conflictana*; western tent caterpillar, *Malacosoma californicum*; and marssonina leaf blight, *Marssonina populi*) and abiotic factors increased from 9,030 acres in 1994 to 14,240 acres in 1995. Defoliation on federal lands in Arizona included the Apache-Sitgreaves National Forest (915 acres), Coconino National Forest (250 acres), Coronado National Forest (45 acres), Kaibab National Forest (675 acres), Prescott National Forest (30 acres), Tonto National Forest (15 acres), and Fort Apache Indian Reservation (775 acres). In New Mexico, aspen defoliation caused by this complex totaled 11,540 acres. This defoliation occurred on the Carson National Forest (4,520 acres), Cibola National Forest (800 acres), Gila National Forest (360 acres), Lincoln National Forest (840 acres), Santa Fe National Forest (4,600 acres), Santa Clara Pueblo Indian Reservation (80 acres), Taos Pueblo Indian Reservation (240 acres) and the Navajo Indian Reservation (100 acres).

Region 9/Northeastern Area:
Minnesota

Host(s): Quaking aspen

Aspen stands in Minnesota experienced over 240,000 acres of defoliation by this complex in 1993 and over 600,000 acres in 1994. In 1995, only 36,540 acres were reported to have defoliation caused by this complex. The complex consists of an omnivorous leafroller (*Archips purpurana*), large aspen tortrix (*Choristoneura conflictana*), obliquebanded leafroller (*C. rosaceana*), dusky leafroller (*Orthotania undulana*), spotted aspen

Declines and Complexes

leafroller (*Pseudosciaphilia duplex*), *Agonoterix argillacea*, and *Epinotia criddleana*.

Brown ash decline

Region 9/Northeastern Area:
Maine

Host(s): Black ash

In Maine, brown (black) ash throughout Maine continued to show symptoms of severe decline on about 120,000 acres, but most plots seem to have improved foliage quantity and quality in 1995. A general decline in brown ash crown conditions, expressed as twig and branch dieback, as well as small and chlorotic foliage, was first detected in 1989 and evaluated on a network of plots scattered throughout Maine.

Hardwood decline

Region 9/Northeastern Area:
Maine

Host(s): American beech, red maple, yellow birch

In Maine, about 180,000 acres in Aroostook, Penobscot, Piscataquis, and Somerset Counties experienced dieback and decline of hardwoods. The dieback and decline, especially in northern Maine, continued in 1995 and appeared to intensify in many stands. Severe drought conditions in all of Maine in 1995 contributed to unusually early fall coloration and leaf drop in hardwood areas and caused considerable stress to beech, red maple, sugar maple, and yellow birch.

Hardwood diseases

Region 6: Oregon and
Washington

Host(s): Alder, poplar, willow, other species

Maintaining and restoring the health of riparian communities is a critical issue, especially in areas that support a threatened anadromous fishery. Little is known about the history of hardwood diseases (and insect pests) in these riparian areas. Riparian restoration is occurring in many parts of the region, making it particularly important that we be able to identify those insects and diseases that contribute to structural diversity as well as impact management goals.

Hardwood insect complex

Region 9/Northeastern:
Pennsylvania

Host(s): Black cherry, maples, oaks

In Pennsylvania, this complex is made up of elm spanworm, fall cankerworm, forest tent caterpillar, and/or eastern tent caterpillar. Over 659,000

acres were defoliated in Pennsylvania, mainly by the eastern tent caterpillar and forest tent caterpillar. In 1995, under the Cooperative Suppression Program, 27,837 acres were sprayed with *Bt* in an effort to suppress this complex.

Oak decline

Region 8: Regionwide

Host(s): Oaks and common associates such as hickories

Oak decline is a disease syndrome resulting in dieback and mortality of dominant and codominant mature oaks. Causal factors are stressors such as drought, frost, defoliation by insects, and opportunistic pathogens and insects such as armillaria root disease and the two-lined chestnut borer (*Agrilus bilineatus*). Host age and site conditions also play a role. Analysis of forest inventory data in 12 southern states indicates that an estimated 3.9 million acres of upland hardwood forest area are affected by oak decline—about 9.9 percent of the vulnerable host type. Average annual mortality volume of oaks on affected sites was 45 percent higher than on unaffected areas. Some of the oak decline reported here is located in areas heavily defoliated by the gypsy moth (see gypsy moth section).

Subalpine fir complex

Region 4: Idaho, Utah,
Wyoming

Host(s): Subalpine fir

During the previous seven years, mortality in subalpine fir has been mostly attributed to western balsam bark beetle (*Dryocoetes confusus*). However, recent ground examinations of this year's widespread mortality suggest that a complex of factors are involved in this mortality. These factors include twig beetles, secondary bark beetles, wood borers, engraver beetles, root diseases, cankers, rusts, drought, stand density, and low vigor.

This complex has resulted in the death of 418,800 trees throughout the region and currently is the most widespread cause of visible mortality in region 4. In Idaho, 78,000 trees were killed during 1995 compared to 61,000 trees in 1994. Large areas of mortality are located on all forests in southern Idaho. In Utah, activity increased with 268,500 trees killed in 1995. Extensive mortality was observed on every forest in Utah. Activity increased in western Wyoming with 72,300 trees killed in 1995 compared to 54,500 trees in 1994.

Yellow-cedar decline

Region 10: Alaska

Host(s): Yellow-cedar

Decline and mortality of yellow-cedar persists as one of the most spectacular forest problems in Alaska. About 595,000 acres of decline have been

mapped during aerial surveys. Concentrated mortality occurs in a wide band from western Chichagof and Baranof Islands to the Ketchikan area, primarily on National Forest System lands (563,400 acres). All research suggests that some site condition, probably associated with poorly drained anaerobic soils, is responsible for initiating and continuing cedar decline. The intense canopy mortality causes change in forest structure, composition, and succession. The large acreage of dead yellow-cedar and the high value of its wood suggest opportunities for salvage. Studies were initiated in 1995 to determine mill-recovery and wood properties of yellow-cedar that have been dead for varying lengths of time.

Seed Orchard Insects and Diseases

Coneworms, *Dioryctria* spp.

Region 5: Northern California Host(s): Afghanistan pine, ponderosa pine

Several species of coneworm have been found at the Chico Genetic Resource Center by a research entomologist. The taxonomic picture remains unclear.

Region 8: Regionwide Host(s): Southern pines

Coneworms continued to cause damage in seed orchards across the South. Data from the Southwide Coneworm Survey showed large populations of the webbing coneworm, *Dioryctria disclusa*, in the Atlantic Coast States. This species was trapped in large numbers in June in orchards in South Carolina. The southern pine coneworm, *D. amatella*, and the loblolly pine coneworm, *D. merkei*, occurred in large numbers in October in orchards in Texas, Mississippi, and Georgia. Additionally, first-generation southern pine coneworm occurred in significant numbers in Texas. Coneworm damage significantly reduced the survival of loblolly, longleaf, shortleaf, and slash pine in untreated sources on federal seed orchards in Arkansas, Louisiana, and Mississippi.

Filbertworm,
Cydia latiferreana
Acorn weevil,
Curculio spp.
Conotrachelus spp.
Pip gall wasp,
Callirhytis operator
Carpenterworm,
Prionoxystus robiniae
Scale,
Eriococcus spp.
Stone gall,
Callirhytis fructuosa

Region 8: Tennessee, Arkansas Host(s): Northern red oak, white oak

The Northern Red Oak Seed Orchard in Tennessee has suffered an outbreak of scale, *Eriococcus* spp., over 50 percent of the orchard. This outbreak caused premature acorn drop and stunted growth of stems on affected trees. It is not certain at this time what impact the scale will

have on the 1996 flower crop. Insecticidal measures killed active carpenterworm cavities on 90 percent of the infected trees; however, pheromone trap catches show there was a large population of moths in the orchard. There was also a re-emergence of stone gall damage. The last significant damage from this insect was reported in 1990. Stone galls are a mass of stony gall cells that can fill the entire interior of the acorn, thus replacing the seed and preventing germination.

On monitored research plots on the Ouachita and Ozark National Forests, this group of insects was responsible for substantial destruction of the white oak acorn crop. The acorn weevils and the filbertworm are primary pests of white oak in the areas studied. In 1995, acorn weevils were responsible for about 20 percent of damaged and destroyed acorns in the research areas.

Pitch canker,
Fusarium subglutinans

Region 8: Florida

Host(s): Slash pine

The outbreak of widespread and serious damage (including tree mortality) reported on slash pines in the southern half of peninsular Florida in 1994 under “Declines/Complexes—Slash Pine Mortality” is apparently stabilizing. This pattern is at least qualitatively similar to historical outbreaks of pitch canker, an insect-associated disease caused by the fungus *Fusarium subglutinans*. Numerous smaller and disjunct outbreaks of pitch canker infections and damage are still occurring in slash pine plantations throughout much of northeastern Florida.

Seed bugs,
Leptoglossus corculus
Tetyra bipunctata

Region 8: Regionwide

Host(s): Southern pines

Seed bug populations in seed orchards continued to cause damage across the South. Damage varied by geographic location and pesticide treatment. Untreated seed orchards and those with limited spray schedules are often severely damaged. On monitored orchards in Louisiana and Mississippi, these insects accounted for confirmed losses of 2 to 28 percent of seed harvested. These percentages likely result from seed bugs feeding during development of the cones. Additionally, seed bugs cause significant loss due to conelet abortion, especially in longleaf pine.

Southern cone rust,
Cronartium strobilinum

Region 8: Southern Georgia,
 Southern Alabama, Florida

Host(s): Slash pine, longleaf pine

The occurrence of this periodically serious disease and its associated damage (loss of cones/seed) reached epidemic levels in slash pine and to a lesser extent longleaf pine in much of the lower coastal plain in 1995. Infections/losses in 1995 exceeded 50 percent of first-year conelets in at least 8 commercial slash pine seed orchards in Florida and southern Alabama. 1995 was the third consecutive year of higher than usual levels of cone rust infections in Florida. It is speculated that the elevation levels of disease occurrence are related to the lack of sufficiently cold and/or freezing temperatures over the past several winters.

**Western conifer seed
 bug,**
Leptoglossus occidentalis
**Lodgepole pine cone
 moth,**
Eucosma rescissoriana
Fir cone worm,
Dioryctria abietivorella

Region 1: Idaho, Montana

Cone and seed insects are becoming of increased significance in region 1 because of the high value of the blister-rust-resistant western white pine seed being produced, and because several orchards of other tree species are reaching cone-bearing age. The primary insect pests of concern are the western conifer seed bug, *Leptoglossus occidentalis*; the lodgepole pine cone moth, *Eucosma rescissoriana*; and the fir cone worm, *Dioryctria abietivorella*. The western conifer seed bug was again abundant throughout northern Idaho in 1995. It was potentially damaging enough at the Coeur d'Alene white pine seed orchard to require insecticidal spraying. Also, spraying was required at the Moscow, Idaho, seed orchard to control seed bugs, cone worms, and cone moths.

White pine cone beetle,
Conophthorus coniperda

Region 8: Tennessee, North
 Carolina

Host(s): Eastern white pine

White pine cone beetle populations increased dramatically in three of the four Tennessee orchards in 1995. At both the USDA Forest Service Beech Creek Seed Orchard and the North Carolina Division of Forestry, Edwards Seed Orchard, beetle populations were up slightly from 1994.

Nursery Insects and Diseases

Black vine weevil, *Otiorhynchus sulcatus*

Region 5: Northern California

Host(s): Douglas-fir, red fir

Damage continued in some blocks of the Humboldt Nursery.

Charcoal root disease, *Macrophomina phaseolina*

Region 5: California

Host(s): Red fir

Charcoal root rot, caused by *Macrophomina phaseolina*, killed approximately 5 percent of the 1+0 red fir crop at Placerville Nursery. Two years ago the nursery discontinued fumigating with methyl bromide, and pathogenic microsclerotia have built up in the soil.

Damping-off, *Fusarium* spp.

Region 6: Oregon, Washington

Host(s): Conifers

The nurseries experienced an average of less than one percent mortality to damping-off caused by *Fusarium* spp. and *Pythium* spp. Fumigation, deep watering, and delayed fertilization helped control damping-off.

Region 8: Regionwide

Host(s): Southern pines

Damping-off is the most common disease problem that faces southern nurseries. The loss of seedlings to damping-off is highly variable from year to year, due to the interaction of pathogenic fungi (species of *Fusarium*, *Pythium*, *Rhizoctonia*, and *Phytophthora*) and environmental conditions. Seedling losses can be severe when germination of seedlings is slow due to cold-wet weather. The most common insect problems in the southern nursery are damage by cutworms (Family: *Noctridae*) and white grubs (*Phyllophaga* spp.). These insect problems are considered a slight periodic problem by a third of the nursery managers.

Approximately two million seedlings were lost in one nursery in Alabama due to *Pythium* and *Phytophthora* spp.

Fusarium root disease,
Fusarium spp.

Region 4: Idaho, Utah

Host(s): True firs, Douglas-fir, Ponderosa pine, Spruce

Fusarium oxysporum causes small amounts of mortality, primarily of 1+0 conifer seedlings, at the Lucky Peak Nursery, Boise National Forest, Idaho and the Lone Peak Nursery in Utah.

Region 6: Oregon

Host(s): Conifers

Effects of fusarium root and hypocotyl rot, *Fusarium* spp., from the previous year carried into the second growing season resulting in culling a portion of the 2+0 crop at one nursery.

Gray mold,
Botrytis cinerea

Region 6: Oregon, Washington

Host(s): Conifers

Damage by gray mold has been kept low (less than one percent of crop damaged) through applications of fungicide, regulation of seedbed densities, and prompt removal of dead material, including pruned tops, from nursery beds.

Lygus bug
Lygus spp.

Region 6: Oregon

Host(s): Western larch

Late in the season, some lygus bug feeding damage occurred in 1+0 larch at one nursery.

Region 8: Florida

Host(s): Conifers

Seedling damage from lygus bug feeding resulted in the loss of 100,000 sand pine seedlings in a Florida nursery.

Phytophthora root rot,
Phytophthora spp.

Region 4: Idaho, Utah

Host(s): Douglas-fir, spruce

These fungi, *Phytophthora* spp. and *Pythium* spp., occur infrequently on seedlings and in soil at the Lucky Peak Nursery, Boise National Forest,

Nursery Insects and Diseases

Idaho and the Lone Peak Nursery in Utah. Infection results in patch mortality and culling of 2+0 seedlings.

Region 6: Oregon, Washington Host(s): Conifers

Seedbed seedling damage was confined to nursery beds with poor drainage or compaction layers in the rooting zone.

Pitch canker, *Fusarium subglutinans*

Region 8: Alabama, Kentucky,
North Carolina, Tennessee Host(s): Southern pines

Pitch canker was the cause of significant losses (100,000 plus seedlings) in longleaf containerized seedlings in North Carolina and Alabama nurseries. Bareroot seedling losses from pitch canker were also reported for longleaf pine in North Carolina and shortleaf pine in Kentucky.

Rhizoctonia needle blight, *Rhizoctonia* spp.

Region 8: South Carolina Host(s): Conifers

Rhizoctonia needle blight caused the loss of 300,000 longleaf pine seedlings in a South Carolina nursery.

Seedling diseases,

Region 1: Idaho, Montana Host(s): Conifers

The most common and damaging diseases of conifer seedlings in nurseries in region 1 in 1995 are root diseases caused by *Fusarium* spp. These fungi cause damping-off and root diseases on many different conifer hosts in bareroot and container nurseries. The most common soilborne pathogen species in bareroot nurseries is *F. oxysporum*, although several other species are also commonly isolated from infested soil and diseased seedlings. The major pathogen in container nurseries is *F. proliferatum*, although *F. oxysporum* and several other fusaria occur at high levels in some nurseries. Although all conifer species are susceptible, most damage occurs on Douglas-fir, western larch, western white pine, and Engelmann spruce. *Botrytis cinerea* is prevalent on nursery seedlings at several locations and causes high levels of damage to container-grown western redcedar and western larch seedlings. In 1995, it caused unusually high levels of damage to container-grown western redcedar seedlings at the Forest Service nursery in Coeur d'Alene, Idaho. *Cylindrocarpon* spp. (especially

C. destructans) caused losses to western white pine and whitebark pine seedlings. Damage to other conifer species also occurred, but root decay of five-needle pines was most serious. Tip dieback caused by *Sirococcus strobilinus*, *Sphaeropsis sapinea*, and *Phoma eupyrena* occurred at several nurseries on bareroot pine seedlings. Ponderosa pine and lodgepole pine were the most commonly affected species. *Pythium* root disease (mostly from *P. ultimum*) occurred at most bareroot nurseries and was also found in container seedlings. Damage was usually minor and mitigated by improving water drainage in soil and container media.

Abiotic Damage

Chemical damage

Region 2: Colorado, South Dakota

Host(s): Many hardwoods and coniferous species

In Colorado, toxic gas emissions (methane, carbon monoxide, hydrogen sulfide, etc.) above subsurface coal beds at Vallencia Canyon on the Southern Ute Reservation caused widespread mortality of pinyon pine and juniper along two 1/3- to 1/2-mile-long strips of land. Herbicide damage to windbreaks and other tree plantings continues to be a serious problem in all states.

Drought effects

Region 2: Colorado, Kansas, Nebraska, South Dakota, Wyoming

Host(s): Many hardwoods and coniferous species

The prolonged drought that has affected region 2 abated with the coming of heavy rains and snowfall in the spring of 1995. No significant impacts due to drought were reported this year.

Region 5: California

Host(s): Conifers, some hardwoods

Conifer mortality due to drought-induced moisture stress followed by bark beetle attack continued in California. Mortality of sugar pine due to moisture stress and subsequent mountain pine beetle attack is of special concern.

Region 9/Northeastern Area: Massachusetts, New Hampshire, New York, Rhode Island, Vermont

Host(s): American beech, firs, northern red oak, paper birch, shagbark hickory, spruces, sugar maple, white oak, other hardwoods

In Massachusetts, 727 acres were damaged in Berkshire County due to drought conditions. In New York, drought was responsible for dieback and decline on 3,080 acres of sugar maple trees in Chautauqua and Ulster Counties and mortality on 100 acres in Cattaraugus County. In Rhode Island, drought occurred statewide in 1995. In Vermont, dry early-growing-season conditions caused browning by late July on approximately 6,500 acres.

Low water/flooding

Region 2: Colorado

Host(s): Cottonwood

Locally severe loss of cottonwoods along the Poudre River near Ft. Collins resulted from the re-routing of the river channel and decreased available water supply to roots.

Region 9/Northeastern Area:
Iowa, Missouri

Host(s): Black walnut, hackberry, oaks, silver maple

In addition to the 11,000 acres of mortality in 1994 from the floods of 1993, Iowa reported 1,313 acres of mortality in 14 counties. In Missouri, mortality of oaks and silver maple continued from the flood of 1993, mostly along the Mississippi River. Trees along the Mississippi River below St. Louis did not survive in 1994. Mortality increased along the Missouri River due to 1995 flooding. Surviving silver maples in all affected areas are showing extensive bole damage—swelling, vertical cracking, and bark sloughing up to previous flood depth. The total acreage of mortality due to flooding in Missouri was 181,057 acres.

Ozone injury

Region 5: California

Host(s): Jeffrey pine, ponderosa pine

Ozone injury to pines in southern Sierra Nevada air pollution monitoring plots has increased slightly. On 26 plots on the Sierra National Forest, 46 percent show more chlorotic mottle injury, 39 percent no change, and 15 percent showed less injury. Plots with trees experiencing the largest increases in injury were mainly at elevations of 4,000 to 5,000 feet, whereas the few plots with slightly improved scores were at 6,000 feet or higher.

In southern California, ozone injury to ponderosa and Jeffrey pines in the San Bernardino National Forest showed a gradient of decreasing injury from west to east—65.7 to 26.7 on an 100-point basis. At Barton Flats on the same forest, the ozone injury index in 1995 was 47.4 and has varied little since 1992.

Region 8: Regionwide

Host(s): Eastern white pine and various bioindicator species

Tipburn was observed on eastern white pine throughout the South. Bioindicator plants were used to assess ozone levels in Class I Wilderness Areas in North Carolina and Georgia. The Class I Wildernesses are surveyed on an annual basis and results are compiled and displayed in tabular format with interpretation as field office reports. The reports are used by air resource specialists as tools in permit evaluation. There were slight differences between data collected in 1995 compared to 1994.

Abiotic Damage

Porcupine feeding

Region 2: Colorado, South Dakota, Wyoming

Host(s): Engelmann spruce, lodgepole pine, subalpine fir

Widespread damage due to porcupine feeding (dead tops and stripped bark) was observed in all coniferous species at Buttermilk Ski Area (Aspen Ranger District, White River National Forest).

Snow damage

Region 2: Colorado

Host(s): Hardwood species

Unusually early and significant snowfall, ranging from one to nine inches, occurred in portions of eastern Colorado, western Kansas and western and central Nebraska on September 20, 1995. Fully foliated trees were particularly susceptible to limb and branch breakage. Species most affected were cottonwood, green ash, elm, and willow. Communities in the Denver area were most affected, and cleanup operations took several weeks.

Wind damage

Region 2: Colorado

Host(s): Engelmann spruce, subalpine fir

Strong winds and above average springtime precipitation (resulting in saturated soils) were responsible for scattered groups of blowdown over large areas of Colorado. Several areas had significant blowdown. A quarter of a million board feet of spruce in the Fern Creek drainage (near Creede) blew over in addition to 60,000 board feet just west of Wolf Creek Pass (West Fork area). Scattered windthrow and breakage was also reported at Beaver Lake Campground (Ouray Ranger District, Uncompahgre National Forest).

Region 4: Idaho, Utah

Host(s): Aspen, various conifers

Approximately 19,500 acres of Englemann spruce, aspen, and subalpine fir were blown down on the Escalante Ranger District of the Dixie National Forest. Approximately 26,000 trees, or 1.3 trees per acre, were affected. Englemann spruce beetle may be of some concern. Some salvage activities have occurred in the area. Scattered areas of small patch blowdown also occurred on the Boise and Bridger-Teton National Forests.

Region 8: Alabama

Hosts: All species

Hurricane Opal hit southeast Alabama on October 5, 1995. Coffee, Covington, Escambia, and Geneva counties were the most severely affected. Damage consisted primarily of blowdowns in high-value, open pine stands

of large trees such as seed-tree or thinned sawtimber. About 25 percent of the forest land in this area was affected.

Region 9/Northeastern Area:
Iowa, Massachusetts,
Minnesota, New York,
Vermont

Host(s): Aspen, American beech, black cherry, eastern white pine, Jack pine, northern red oak, red oak, sugar maple, white ash

In Iowa, over 300 acres of mixed species were damaged by high winds. In Berkshire County, Massachusetts, a May tornado caused damage to 1,361 acres and July thunderstorms also caused damage to 2,717 acres. In New York, almost 44,000 acres were damaged by wind in Cattaraugus, Jefferson, and Lewis Counties. In Vermont, heavy winds in July, October, and November blew down trees over a widespread area and caused occasional patches of blowdown in the Green Mountains. In northern Minnesota, windstorms on July 13 and 14 occurred over all forest types in the state, but predominantly affected the aspen/birch forest type. Extreme straight line winds blew down millions of trees on 241,800 acres over an 8-county area.